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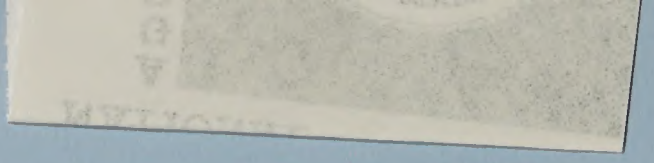
MASSACHUSETTS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMICS, STATISTICS, and COOPERATIVES SERVICE
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IN COOPERATION WITH:

MASSACHUSETTS WATER RESOURCES COMMISSION

1978



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MASSACHUSETTS WATER RESOURCES STUDY

COASTAL REGION REPORT

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SUMMARY

1.1 INTRODUCTION

This is a report of a study of the water and related land resources of the Coastal Region, prepared by the U.S. Department of Agriculture (USDA) and the Massachusetts Water Resources Commission. There will be similar reports for the remaining regions of Massachusetts. The objectives of this study are to identify problems, determine needs through 1990, and suggest alternatives which can be used by the Massachusetts Water Resources Commission to prepare a comprehensive state water and related land resources plan. Information contained in this report will be useful to state, regional, and local agencies concerned with land use and natural resource planning.

For the purposes of the Massachusetts Water Resources Study, the state was divided into four regions: Berkshire, Connecticut River, Central, and Coastal. The Charles River watershed was not included, since studies[1/] in that area were completed in 1972 in a cooperative Charles River Implementation Study,[2/] with the Corps of Engineers. Figure 1.1 indicates the regions.

The Coastal Region, approximately 2,600 square miles, consists of small watersheds which flow directly into the Atlantic Ocean. Major streams are the Parker, Ipswich, Saugus, Mystic, Neponset, North, Taunton, Agawam, Weweantic, Westport, Sippican, Mattapoisett, Ten Mile, and Palmer Rivers. The region is composed of 127 cities or towns in eastern Massachusetts.

The Soil Conservation Service; Economics, Statistics, and Cooperatives Service; and the Forest Service are the United States Department of Agriculture agencies participating in this study. The Massachusetts Divisions of Water Resources, Fisheries and Wildlife, Forests and Parks, Water Pollution Control, and the Massachusetts Department of Agriculture are the state agencies most actively involved in this study.

1.2 CONCLUSIONS OF THE STUDY

A. Land Use

The 1975 population of the region was about 2,900,000 people. The population is expected to increase by nearly 11 percent to about 3,209,000 people by 1990.

Land use in the Coastal Region is dominated by forest and urban uses. Approximately 75 percent of the land area or 1,250,000 acres is in the above two land use categories. Over 20 percent of the land is in urban use. Agricultural land, wetlands, water, and "other" land uses contribute to the balance.

During the 20-year period between 1952 and 1972, significant changes in land use have occurred, especially in the agricultural and urban land

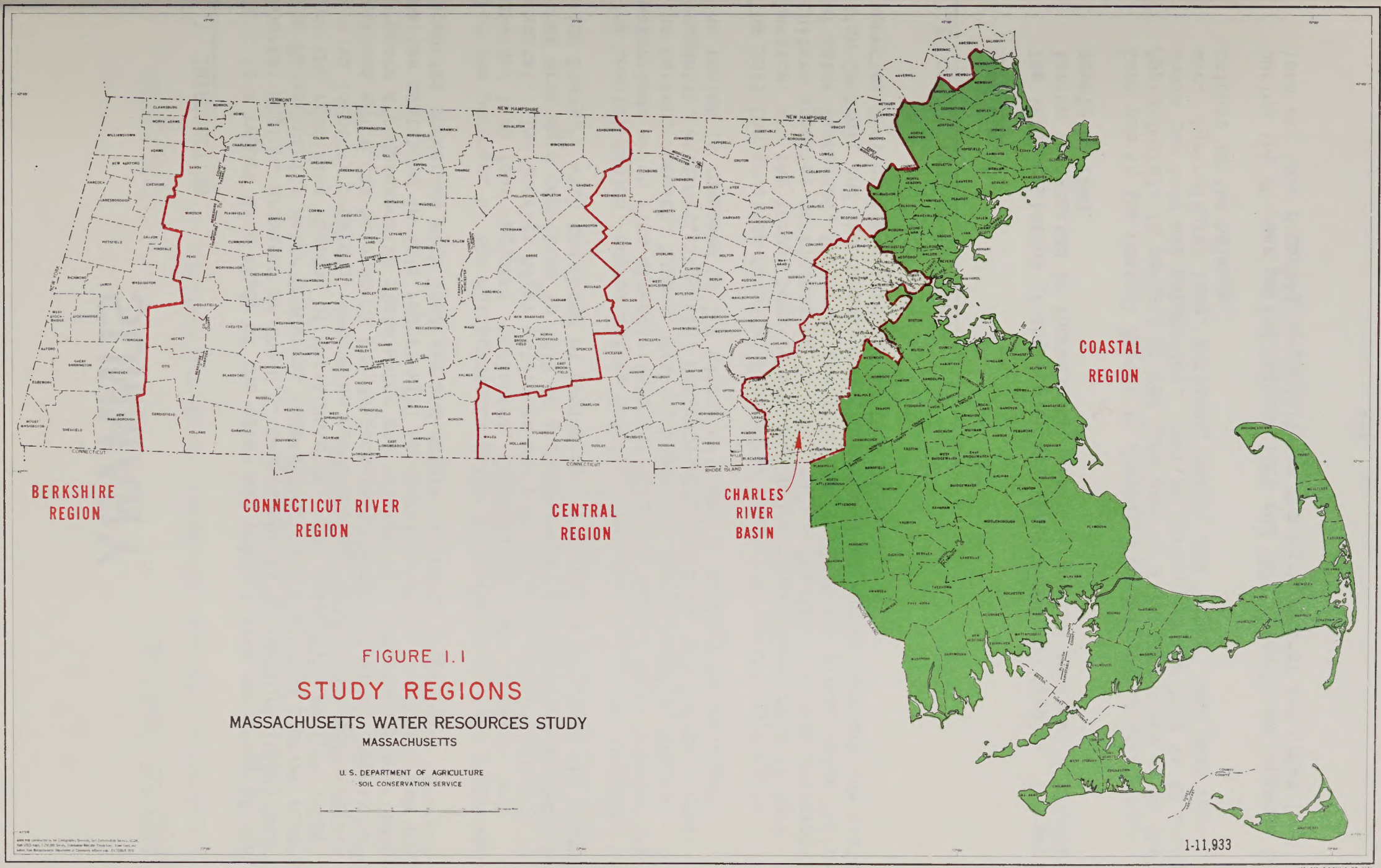


FIGURE 1.1

STUDY REGIONS

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use categories. Agricultural land decreased by almost 99,169 acres, while urban land increased by 145,062 acres. Projections of trends in agricultural land suggest that total land in farms will decrease by 4.2 percent (6,574 acres) between 1974 and 1990. Projections also indicate that urban land is expected to increase by 16 percent (54,191 acres) by 1990.

The state as well as the region is experiencing a continuing decrease in the quantity of agricultural land. The loss of suitable farmland soils to other land uses is nearly irreversible. In addition to reducing the land base available for growing food, the loss of farmland results in a deterioration of the visual and aesthetic quality of the environment. Alternatives and remedial measures are suggested which, if implemented, might stem the trend of decreasing agricultural land use.

Forestland presently occupies 908,000 acres or 54 percent of the region. Projections suggest that forestland will decrease to 863,000 acres by 1990. Private owners own the majority of the forested land, and much of the land consists of small tracts. Land is owned for a variety of reasons, only a small proportion for timber production purposes, and perhaps only one-half the forestland is available for wood product production. Alternatives to increase wood product production include an increase in personnel; increase in forest program funding and forestland ownership incentives; development of diversified markets for low quality wood; and an increase in information and education programs.

B. Inland Flooding

Within the last 50 years, many floods have occurred in the region, but the more significant regional floods occurred in 1938, 1944, 1955, and 1968. These floods damaged residences, commercial buildings, industrial plants, farm fields, roads, and bridges.

Average annual flood damage in the region exceeds $2,750,000. A 100-year frequency flood would cause damage in excess of $21,000,000.

To reduce flood hazard risks in future development, many towns in the region are adopting flood plain management techniques, such as flood plain zoning and flood insurance. All but ten towns have joined the National Flood Insurance Program, and property owners can now purchase low cost flood insurance. In return for this federally-subsidized insurance, the towns are required to regulate future construction in flood hazard areas.

As a result of the flood insurance program and the growing tendency to adopt flood plain management measures, future flood plain development is expected to be highly restricted. As a consequence, flood damage is not expected to increase significantly.

Flood plain regulations and flood insurance will not reduce flood damage to existing development. There is a need to develop alternatives to reduce flood damage in the region to an acceptable level. Alternatives

are available to significantly reduce flood damage. Three combinations of corrective flood plain management techniques were investigated in this study. Floodproofing, structural measures, or a combination of floodproofing and structural measures offer viable alternatives to continued flood damage.

C. Erosion and Sediment

The region is blessed with generally less severe erosion and sedimentation problems than much of the rest of the United States. However, these problems cannot be discounted entirely. The annual erosion in the region is approximately 690,000 tons. About 69,000 tons of sediment are delivered to watercourses each year. Erosion from construction sites accounts for over 340,000 tons per year. Tilled cropland accounts for 60,000 tons. Wind erosion from sand dunes, gravel pits, and utility rights-of-way results in nuisance-type problems for nearby residents.

Enactment of erosion and sediment control ordinances, stabilization of critical erosion problem areas, and increased emphasis on the installation of land treatment measures on tilled cropland are suggested as alternatives to alleviate the erosion and sediment problems.

D. Wetlands

The 159,000-acres of inland wetlands and 40,000-acres of saltwater wetlands in the region provide many benefits, including flood control, wildlife habitat, open space, and water quality protection. The ongoing wetlands programs, especially Massachusetts' pioneer wetlands legislation, will go far in protecting wetlands from harmful alteration.

Increased public acquisition of wetlands, acceleration of the Inland Wetlands Restriction Program, and expanded conservancy zoning of wetlands are included in the alternatives. The Saltwater Wetlands Restriction Program is expected to adequately protect all salt marshes by 1990.

E. Water Supply and Irrigation

The municipal water for the Coastal Region is supplied from groundwater and surface sources, and by purchase from the Metropolitan District Commission (MDC). Additional municipal water supply is needed. Diversion of Connecticut River water is being considered to meet 1990 needs of the Boston metropolitan area served by the MDC. Appendix A of this report identifies 33 potential reservoir sites which might fill needs for municipal water supply for individual communities or small regional systems.

Irrigation water used by agriculture represents a very small part of the total water supply and water use in the region. The majority of irrigation water is used in the production of cranberries. Water supplies for this purpose are expected to be adequate to meet 1990 needs.

F. Water Quality

Existing programs and regulations are adequate to enable the region to meet water quality goals. Point sources of pollution have been drastically reduced in the past five years, and additional progress is expected. Nonpoint sources of water pollution are receiving increased attention under Section 208 of the Water Pollution Control Act Amendments of 1972.

Alternatives in the area of Water Quality include acceleration of the soil survey program in the region.

G. Recreation

Projections in the Statewide Comprehensive Outdoor Recreation Plan indicate that an unmet demand exists now and will exist in 1990 for camping, picnicking, canoeing, sailing, and hiking. The gap between demand and supply is so large that it will be practically impossible to meet projected needs. Alternatives are presented, however, which can meet some of the needs.

Alternatives include development of environmental corridors, development of canoe trails, and implementation of the Massachusetts Scenic and Recreational Rivers Act.

1.3 SUMMARY TABLES

Table 1.1 summarizes the major findings, problems, potential solutions, and program opportunities determined, as a result of this study.

TABLE 1.1 - PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
1. Land Use	1. Agricultural land acreage has declined 48% from 1952 to 1972 & is projected to decline further.	Develop programs that help maintain agricultural land use.	Identify prime agricultural lands.	Farm management and farm account work at U. of Mass. and with Cooperative Extension Service. Chapter 61A of the Mass. General Laws, Chapter 780, Acts of 1977, Chapter 232, Acts of 1977.
	2. Forestland (approximately 54% of the region) is underutilized for the production of wood products.	Increase management of public & private land. Increase incentives to landowners. Develop diversified markets. Establish an information and education program.	1. Resource Conservation & Development program. 2. Cooperative Forest Management program. 3. General forestry assistance program. 4. Harvest improvement program. 5. Forestry Incentive Program. 6. Sawmill improvement program.	1. Chapters 61 and 61A of Mass. General Laws. 2. Farmers Home Administration. 3. Small Business Administration.

TABLE 1.1 - PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
2. Flooding	1. Future urban flood plain development is expected to be highly restricted.	Enroll towns not now in National Flood Insurance Programs.		HUD National Flood Insurance Program.
	2. Average annual flood damage to existing development exceeds $2,750,000.	Implement plans for structural measures and flood proofing to reduce flood damages.	1. PL 83-566, Watershed Protection & Flood Prevention Act, administered by USDA, SCS. 2. RC&D Program.	Corps of Engineers' Small Watersheds and Emergency Projects.
3. Erosion and Sediment	1. Erosion on construction sites is an important erosion problem.	Develop erosion and sediment control ordinances at the municipal level.	Conservation Operations Program, SCS.	Technical assistance from Conservation Districts with inputs from Cooperative Extension Service and County Regional Planning Commissions.
	2. Region has critical erosion problem areas and problem streambanks.	Develop Resource, Conservation & Development project measure to stabilize critical areas and problem streambanks.	RC&D Program.	
	3. Erosion rates on tilled cropland are unacceptably high and result in lowered agricultural productivity.	Inventory cropland with serious erosion problems. Establish priorities for technical and financial assistance to assist landowners install practices to reduce erosion losses.	Conservation Operations Program, SCS.	Technical assistance from Conservation Districts.

TABLE 1.1 - PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
4. Wetlands	1. Region has 159,000 acres of inland wetlands which should be protected from harmful alteration.	Accelerate Inland Wetlands Restriction Program.		
		Acquire additional 20,000 acres of inland wetlands by 1990.		Financial assistance for cities and towns for acquisition, state - Self-Help Fund, Gen. Laws, Ch. 132A, Sec. 11. Federal - USDI - BOR Land and Water Conservation Fund.
		Expand conservancy zoning to include majority of the region's wetlands.	Mass. Natural Resources Technical Team.	Technical assistance from Conservation Districts.

TABLE 1.1 - PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
5. Water Quality	1. Ongoing problems on verge of reestablishing high water quality in the streams of the region. 2. "Section 208" water quality studies underway in the region.			
	3. Detailed soil survey information is not available for entire region.	Provide detailed soil survey.	Special soils surveys and interpretations to be prepared for towns by SCS.	
	4. Water pollution from pesticides and herbicides used in cranberry operations are a potential problem.	Continue to educate operators concerning potential water quality hazards.	Cooperative Extension Service. Cranberry Experiment Station.	

TABLE 1.1 - PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
6. Water Supply and Irrigation	1. Additional municipal water supply will be needed by 1990.	Additional water supply can be developed from groundwater and/or surface water sources. Diversion of Connecticut River water may be needed to meet MDC needs. Potential surface water reservoirs indicated in Appendix A.	USDA Farmers Home Administration loans for community water supply systems.	HUD loans and financial assistance for municipal water supply.
	2. Little irrigation water use, except for cranberry production. Existing programs are adequate.			

TABLE 1.1 - PROBLEMS AND OTHER FINDINGS OF THE STUDY

Resource Area	Findings/Problems	Potential Solutions and Needed Actions	Program Opportunities	
			USDA	Other
7. Recreation	1. There are insufficient camping, picnicking, and boating facilities.	Provide additional camping, picnicking, swimming, and boating facilities.	Resource Conservation and Development Program.	1. USDI - BOR Land and Water Conservation Fund. 2. Mass. - Self-Help Fund, Gen. Laws, Ch. 132A, Sec. 11. 3. Mass. - Public Access Fund, Gen. Laws, Ch. 21, Sec. 17.
	2. Region has numerous unique natural features.	Plan for preservation of scenic rivers and unique natural areas.	Renewable Resources Program. USDA - Forest Service and Mass. Div. of Forests and Parks. SCS Mass. Natural Resources Planning Program.	Nature Conservancy Program. Mass. Scenic and Recreational Rivers Program.

NOTES

1/ Charles Study Area, U.S. Department of Agriculture, Amherst, Massachusetts, May 1972.

2/ Water Resources Development Plan, Charles River Watershed, Massachusetts, U.S. Army Corps of Engineers, Waltham, Massachusetts, April 1972.



Windmill House at Harwichport, Massachusetts.

2

INTRODUCTION

2.1 GENERAL

The Massachusetts Water Resources Study was initiated by a cooperative agreement between the U.S. Department of Agriculture (USDA) and the Massachusetts Water Resources Commission (MWRC). This water and related land resources study provides data to the Commission for use in the preparation of an overall State Water and Related Land Resources Plan.

2.2 AUTHORITY FOR USDA AND OTHERS' PARTICIPATION

The USDA participated in this study at the request of the MWRC. Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended) authorizes such participation by USDA. The Forest Service; Economics, Statistics and Cooperatives Service; and the Soil Conservation Service are the USDA agencies participating in this study.

Under state law, the MWRC has the responsibility to develop an overall plan and to coordinate federal, state, and other agency activities in the water resources field.

The Massachusetts Divisions of Water Resources, Forests and Parks, Fisheries and Wildlife, and Water Pollution Control, and the Massachusetts Department of Agriculture are the state agencies most actively involved in this study.

2.3 OBJECTIVES AND NATURE OF STUDY

Water and related land resource planning by federal agencies is guided by the Principles and Standards (P&S) established by the federal Water Resources Council. The Principles and Standards established a thorough and organized approach to water and related land resource planning for two broad objectives:

> National Economic Development (NED)--to enhance national economic development by increasing the value of the nation's output of goods and services and improving national economic efficiency.
>
> Environmental Quality (EQ)--to enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.[1/]

2.4 PLANNING PROCEDURES AND REPORT PRESENTATION

The planning process, established by the P&S, is designed to produce a recommended plan. The Massachusetts Water Resources Study planning process differs in that the process stops with the development of alternatives. The selection of a final or recommended plan is the responsiblity of the Massachusetts Water Resources Commission.

This study investigated the following resource areas in detail: Land Use, Inland Flooding, Erosion and Sediment, and Wetlands. The resource areas of Water Quality, Water Supply and Irrigation, Drainage, Fish and Wildlife, and Recreation are ordinarily subjects of investigation for a cooperative water resources study. In the Coastal Region, however, these resource areas have been studied in detail by other levels of water resources studies, state sponsored studies, and by consulting engineers and planners. To avoid duplication of effort and to allow more time and effort to be expended upon the four areas studied in detail, it was decided to only briefly investigate the other areas. In some cases, the data and conclusions from previous studies are reported to maintain continuity. In other instances, it was found that new resource data could be generated in a specific phase of a resource area. The principles which guided study intensity were:

1. areas that were adequately covered by previous studies would not be restudied, and

2. only resource areas where the expertise of USDA agencies was recognized would be studied in detail.

The Massachusetts Water Resources Study planning process approximates the first four steps of the P&S process which are, as follows:

1. Specify components of the objectives relevant to the planning setting;

2. evaluate resource capabilities and expected conditions without any plan;

3. formulate alternative plans to achieve varying level of contributions to the specified components of the objectives;

4. analyze the differences among alternative plans which reflect different emphasis among the specified components of the objectives.

In addition, the P&S requires that beneficial and adverse effects of alternatives or plans on National Economic Development and Environmental Quality be displayed. P&S also suggests that beneficial and adverse effects of alternatives be displayed, where appropriate, for Regional Development and Social Well-Being.

Study results are presented in chapters which reflect the P&S suggested planning process. Data findings in each resource area are placed in the appropriate planning chapter, so that the final report enables the reader to follow the step-by-step procedures used to develop the alternatives. The major chapter format is, as follows:

Chapter 3 (Problems and Objectives) - The resource problems are stated in terms of their effect on the two main objectives: National Economic Development and Environmental Quality.

Chapter 4 (Economic Projections and Environmental Considerations) - Projections of social, economic, and natural resources base data are presented, including projections of population, employment, income, urban development, agricultural and forest activity, and other significant social and economic areas. The relationship between the projections and specific components of the National Economic Development objectives are presented. Projections concerning the environmental setting are also contained in this chapter. Effects of population distribution and land use changes on the environment are discussed.

Chapter 5 (Resource Base and Existing Programs) - The existing situation is presented in this chapter. Physical data, such as location, size, soils, geology, vegetative cover, climate, and land use are included. Existing conditions in the four major resource areas (flooding, erosion and sediment, wetlands, and land use) are covered in detail. Existing USDA and other programs which are being utilized to meet resource needs are explained in this chapter.

Chapter 6 (Future-Without-Plan Condition) - This chapter describes the conditions to be expected in each of the resource areas if no new alternatives are planned and implemented. The effects of presently authorized projects are considered along with the effects of nonaction.

Chapter 7 (Needs) - Needs are defined as the difference between conditions expressed in the Economic Projections and Environmental Considerations section and those adequately addressed by ongoing and planned projects described in the Future-Without-Plan Condition Chapter. This chapter quantifies the extent of the problems outlined in the Problems and Objectives Chapter.

Chapter 8 (Alternatives) - This chapter presents a number of alternatives designed to fill the needs expressed in the preceding chapter. Displays showing effects of the alternatives on the four P&S accounts (National Economic Development, Environmental Quality, Regional Development, and Social Well-Being) are included. In addition, alternatives are contrasted with their potential effects on about 20 major environmental indicators.

Chapter 9 (Program Implementation of Alternatives) - The chapter describes how USDA programs can be used to implement the alternatives expressed in Chapter 8. Opportunities for other state or federal programs are also discussed. If no existing programs are available to implement an alternative, the need for new or revised programs is investigated.

2.5 GENERAL DESCRIPTION OF THE STUDY AREA

The Coastal Region includes all the coastal watersheds and offshore islands from the Parker River in the north to the Buzzards Bay and Narragansett Bay drainage in the southeast portion of Massachusetts. It is bounded by the

Merrimack River and the Blackstone River Basins on the north and west, and by the Atlantic Ocean on the east and south. Larger rivers in the region include the Ipswich, Neponset, Taunton, and the Ten Mile.

The region includes the entire counties of Dukes, Bristol, Plymouth, Barnstable, Suffolk, and Nantucket, and parts of Essex, Middlesex, and Norfolk Counties. The region is the cultural and economic center for not only Massachusetts but for the entire New England area.

The region is composed of 127 towns or cities and 10 study areas which are defined on either a watershed or on a natural boundary basis. For the purposes of this study, the 10-study areas were aggregated into three subregional areas with names denoting the geographical location in the state. Figure 2.1 indicates the location of study areas.

Subregion	Study Areas
1. Northeastern	a. Parker b. Ipswich c. North Shore d. Neponset
2. Southeastern	a. South Shore b. Taunton c. Buzzards Bay d. Narragansett Bay
3. Cape Cod and Islands	a. Cape Cod b. Islands

Where applicable, data and findings will be presented for each subregional area. In those cases where no improvement will be made, presentations will be for the entire Coastal Region.

A. POPULATION

The total permanent population of the Coastal Region was 2,901,540 in 1975, an increase of 82,140 since 1970 (2.8 percent) and an increase of 302,907 since 1960 (11.7 percent). In comparison to the regional trend, the Boston population trends were just the opposite, losing populations of 58,197 between 1960 and 1975, and 2,071 between 1970 and 1975. Table 2.1 summarizes the permanent population trends for each of the subregions.

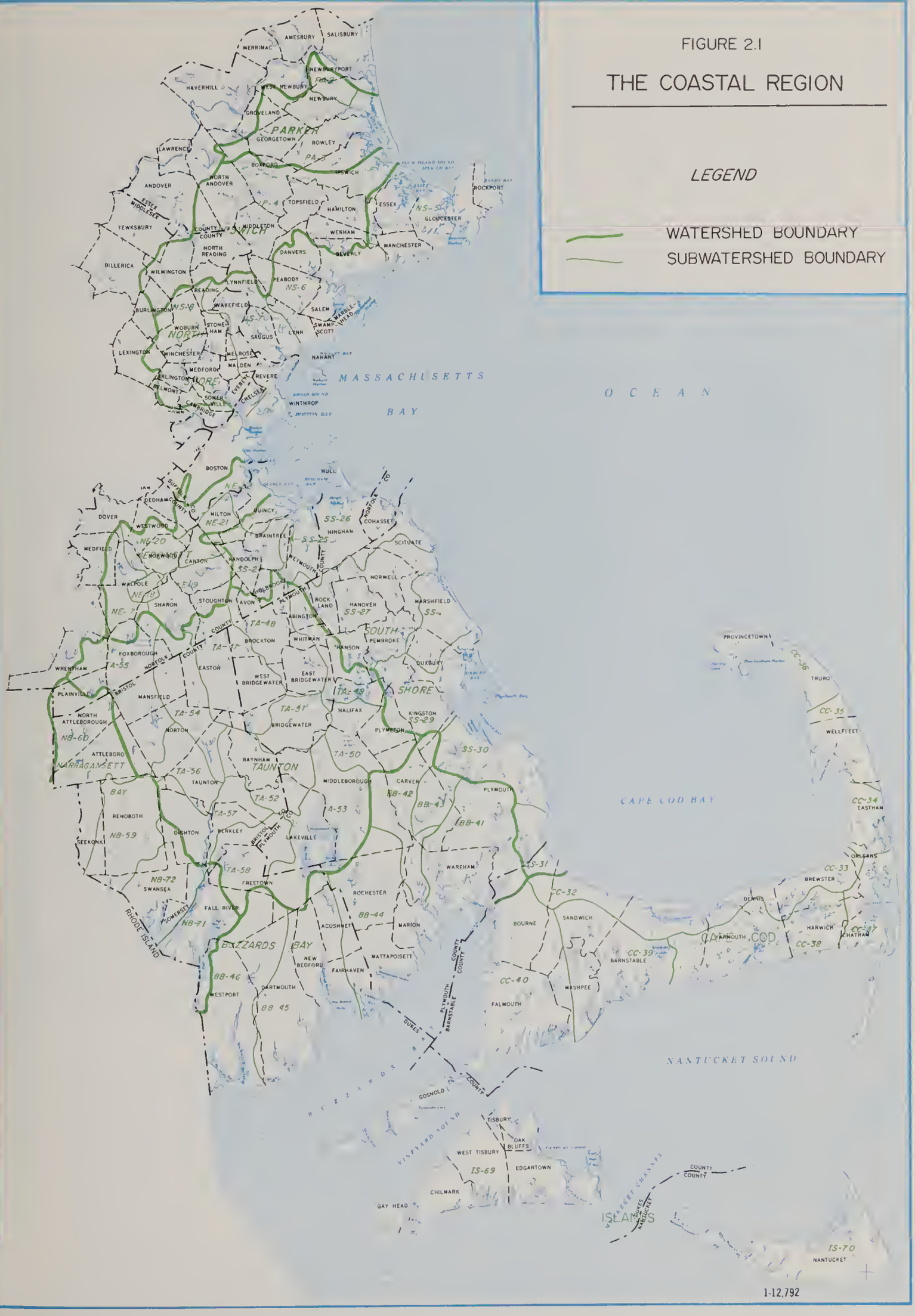

FIGURE 2.1
THE COASTAL REGION
LEGEND
WATERSHED BOUNDARY
SUBWATERSHED BOUNDARY
MASSACHUSETTS BAY
OCEAN
CAPE COD BAY
NANTUCKET SOUND
BUZZARDS BAY
NARRAGANSETT BAY
RHODE ISLAND
PARKER
IPSWICH
NORTH COASTAL
SOUTH COASTAL
NORTH SHORE
SOUTH SHORE
TAUNTON
ISLANDS
1-12,792

TABLE 2.1 - POPULATION AND POPULATION (PERMANENT) CHANGES
1950-1975

Item	Subregion			
	Northeastern	Southeastern	Cape Cod & Islands	Total Coastal Region
1950	1,588,530	751,370	51,353	2,391,253
1960	1,606,923	915,581	76,129	2,598,633
1970	1,648,453	1,067,470	103,447	2,819,370
1975	1,634,966	1,125,464	141,110	2,901,540
Change 1950-75	46,436	374,094	89,757	510,287
% Change 1950-75	2.9	49.8	174.8	21.3
Change 1960-75	28,043	209,883	64,981	302,907
% Change 1960-75	1.7	22.9	85.4	11.7
Change 1970-75	-13,487	57,994	37,633	82,140
% Change 1970-75	-.8	5.4	36.4	2.9

B. ECONOMIC ACTIVITY

Presently, manufacturing is one of the largest employers in the Coastal Region. In 1970, the manufacturing sector employed slightly more than 24 percent of those employed in the region, although this was down from the 1960 figure of 31 percent. The service sector was the largest employer and accounted for slightly more than 29 percent. It is interesting to note that the number of those employed in the service sector increased from 453,772 persons in 1960 (22.6 percent of those employed) to 856,977 in 1970. At the other extreme, agriculture, forest, and fisheries accounted for just .7 percent of the total number employed in 1960 and .5 percent in 1970, while mining employed less than one-tenth of one percent of the total employment.

Between 1960 and 1970, the regional transportation sector experienced a decline of 44.27 percent but, if Boston is excluded, the sector experienced an increase of almost 16 percent. Wholesale trade also illustrates the impact of Boston's employment. Between 1960 and 1970, wholesale trade increased its employment by 11.72 percent of those employed when Boston is included. When Boston is excluded, wholesale trade increased 74 percent.

The data suggests a restructuring of the economic sector from a manufacturing economy to a service-oriented economy. While manufacturing had a decrease of 71,671 persons, the service sector increased by slightly more than 204,000. The trend is the same when Boston is excluded and typifies the New England economy with manufacturing relocating outside of New England to take advantage of lower cost areas.

This purposely brief socio-economic introduction delineates the major socio-economic characteristics of the Coastal Region. The socio-economic discussion will be continued in more detail in Chapter 4.



Gloucester, Massachusetts: A rusting anchor abandoned on the shore at Gloucester Harbor bears mute testimony to the seafaring past of this historic fishing port where men have gone down to the sea in ships for three centuries.

NOTES

1/ Water Resources Council, Water and Related Resources Establishment of Principles and Standards for Planning, Federal Register, Vol. 38, No. 174, Part III, September 10, 1973.



Mashpee, Mass.. Golfing is enjoyed in the autumn sunshine on Cape Cod.

3

PROBLEMS & OBJECTIVES

3.1 INTRODUCTION - PRINCIPLES AND STANDARDS

According to the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources, the overall purpose of water and land resource planning is to promote the quality of life by reflecting society's preferences for attainment of two major objectives:

1. The enhancement of National Economic Development (NED) by increasing the value of the nation's output of goods and services, and improving national economic efficiency;

2. the enhancement of the Environmental Quality (EQ) by the management, conservation, preservation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

The NED objective is attained by measures and actions which result in an increase in the value of goods and services and which improve national economic efficiency. An important component of the NED objective is the value of increased output of goods and services resulting from an action. Water resource alternatives can result in increased production of goods and services which can be measured in terms of increased crop yields, increased recreational use, and reduced flood damages. Increased production from the employment of otherwise unemployed or underemployed resources may also result.

The EQ objective reflects concern for the natural environment and its maintenance and enhancement as a source of enjoyment and a heritage for future generations. Emphasis is given to diverting a portion of the available resources from economic development to achieve environmental goals. As our standards of living increase, there is less willingness to accept environmental damage in exchange for economic gain.

Specific components of the EQ objective include:

1. creation, protection, or improvement of areas of natural beauty and human enjoyment, such as open space, wild and scenic rivers, lakes, beaches, and wild areas;

2. management or enhancement of valuable archeological, historical, biological, and geological resources;

3. enhancement of the quality of water, land, and air resources by control and prevention of pollution, erosion, and misuse;

4. caution in meeting development objectives in order to minimize undesirable and possible irreversible changes in the natural environment.

In each of the major water resource areas of concern, problems can be related to one or both of the major national objectives. Flood damages are a good example of a problem which fits into the category of a National Economic Development problem; i.e., flood damage results in a decrease in the value of goods and services which are produced in an area. The problem of loss of wetlands in a region might logically be classed as both a NED and EQ problem. Loss of wetlands results in loss of wildlife habitat (an EQ loss), as well as an increased potential for flood damage (NED problems).

3.2 PROBLEMS AND OBJECTIVES

Table 3.1 presents problems or concerns for each specific resource area or study concern. Objectives related to problems are presented on two major levels: desires and preferences.



Nantucket, Massachusetts: Sports fishing and pleasure craft tie up at berths in Nantucket Harbor where more than 100 whaling ships once took to the seas. This pioneer whaling town shares honors in Herman Melville's "Moby Dick" with New Bedford on the mainland.

TABLE 3.1 - PROBLEMS AND OBJECTIVES

Resource Area	Problems (Concerns)	Objectives	
		1st Level (Desires)	2nd Level (Preferences)
Land Use - Agricultural Land	NED - Loss of agricultural land to nonagricultural uses.	Preserve agricultural land.	1. Increase net returns to agricultural sector. 2. Determine and minimize the factors that adversely impact upon the agricultural sector.
	EQ - Loss of open land.	Preserve open land.	1. Maintain a viable agricultural sector in order to preserve agricultural land and, thereby, preserve an aesthetically pleasing land use mix.
Land Use - Forestland	NED - Underutilization of forestland resources for the production of wood products.	Increased outputs of wood products.	1. Increase management opportunities for forest landowners. 2. Provide forestland management incentives. 3. Increase market opportunities for wood products. 4. Establish and increase information and education programs on forest management.
	EQ - Lack of forest management in urban areas is resulting in a lessening of environmental quality.	Preserve, maintain, and enhance the quality of the environment and the ecological system.	1. Provide information and education programs on urban forestry. 2. Provide additional technical assistance for management and use of urban forest resources in the region.
Inland Flooding	NED - Periodic flooding causes damage to exisiting residential, commercial, industrial, and public property.	Reduction of flood damage to existing damageable property.	1. Reduction of flood flows. 2. Reduction of susceptibility to flooding.
	NED - Development of flood prone areas increases the damages to be expected from future floods.	Improved economic efficiency from development of flood-free areas.	Guide development away from flood prone areas.
	NED - Loss of wetland flood storage increases flood peaks and flood damage.	Avoid increased flood peaks and resulting damage.	Protection of wetland flood storage from loss by filling.

TABLE 3.1 - PROBLEMS AND OBJECTIVES

Resource Area	Problems (Concerns)	Objectives	
		1st Level (Desires)	2nd Level (Preferences)
Erosion and Sediment	EQ - Materials eroded from unstable areas are resulting in pollution and sedimentation of water bodies and decreased visual quality.	1. Enhance water quality. 2. Enhance visual quality.	Install erosion and sediment control measures. Install erosion and sediment control measures.
	NED - Erosion on cropland results in reduced agricultural productivity.	1. Maintain agricultural productivity.	Reduce erosion losses on cropland.
Wetlands	EQ - Loss or harmful alteration of inland wetlands results in decreased wildlife habitat and visual quality.	Protection of the environmental base.	Protection of wetlands from unwise development.
	NED - Loss of wetland flood storage increases downstream flood peaks and flood damage.	Avoid increased flood peaks and resulting damage.	Protection of wetland flood storage from loss by filling.
	NED - Development of wetlands increases flood damage in the developed wetlands.	Reduce future flood damage.	Protect wetland flood prone areas from development.
	NED - Lack of public access to wetlands is resulting in underutilization of a recreation resource.	Increase wetland recreation opportunities.	Secure public access to wetlands.
Water Quality	EQ - Pollution from point and nonpoint sources is degrading water quality.	Improve water quality.	Identify pollution sources and develop abatement measures.
Water Supply	NED - Existing municipal water supplies will be insufficient to meet 1990 needs.	Increase available municipal water supply yield.	Develop new municipal water sources. Improve existing municipal sources and delivery systems.

TABLE 3.1 - PROBLEMS AND OBJECTIVES

Resource Area	Problems (Concerns)	Objectives	
		1st Level (Desires)	2nd Level (Preferences)
Recreation	EQ - Unique natural, historic, and cultural resources will be lost unless protected.	Management and protection of areas of natural beauty and human enjoyment.	Protect and manage unique natural, historic, and cultural resources.
	NED - Lack of public access to outdoor recreation resources.	Increase recreational opportunities.	Secure access to recreation areas.
	NED - Demand for outdoor recreation exceeds available supply.	Increased recreational opportunities.	Develop water-based recreational resources.



Eastham, Massachusetts: The Atlantic Ocean washes the sands of Coast Guard Beach at the Cape Cod National Seashore, which stretches from Chatham at the mid-cape to Provincetown at the outermost tip. The beach is a favorite place for surf fishing for striped bass.

4

ECONOMIC PROJECTIONS & ENVIRONMENTAL CONSIDERATIONS

4.1 HISTORIC DEVELOPMENT - GENERAL ECONOMIC DEVELOPMENT AND SIGNIFICANT EFFECTS ON THE ENVIRONMENT

Prior to colonization by England, the Coastal Region was inhabited by native people of the Wampanoag and Massachusetts tribes. Agricultural products and fisheries were the main food supplies of the natives who lived in a dominant woodland cover.

In terms of major activities, the Coastal Region has progressed through two economic periods and entered a third. Shipbuilding, shipping, and fishing were the major commercial activities between colonization and the early 1800s. The long coastline with many natural deep anchorages and nearby timber resources gave rise to a large shipbuilding industry which subsequently developed into shipping and fishing activities. Shipping of raw products from the colonies to England and returning with manufactured goods became the most prevalent trade pattern.

England's imposition of the Stamp and Sugar Acts had a severe negative impact upon shipping, and this impact continued until after the Revolution. With the cessation of hostilities, shipping prospered until 1807, when an embargo was placed on American shipping by the federal government. As shipping floundered, resources were diverted to manufacturing, marking the beginning of the second economic period. Although shipping and related industries were the major economic activities, manufacturing was a viable sector. The rivers that supplied an inexpensive source of power, plus the comparative advantage in water transportation, were important factors in the development of manufacturing. Although manufacturing remained the dominant economic sector through the 1960s, two economic factors dictated a decline. The first involved a transportation shift from water to land. Initially, the railroads brought about this change which was sealed with the development of the interstate highway system. The other factor involved the introduction of nonwater generated power, initially steam and subsequently electricity. With the loss of the region's comparative advantage in power and transportation, manufacturing declined prior to World War I and reached its nadir between 1950 and 1970.

As a result of these structural changes, capital investments declined in the manufacturing sector and were diverted to service-related activities. As an illustration of this trend, between 1960 and 1970, employment in manufacturing decreased 11.5 percent (from 621,208 to 549,537), while employment in the service sector increased 45 percent (from 453,722 to 658,149).

The employment figures presented in Table 4.1 illustrate the dominance of Boston in the region. The decrease in manufacturing between 1960 and 1970 goes from 11.5 percent with Boston included, to 2.5 percent with Boston excluded. Similarly, the increase in the service sector goes from 45 to 59 percent.

Like the manufacturing sector, the agricultural sector evolved through three economic or productive stages:

1. Pre-railroad (ending about 1840)--agricultural production concentrated primarily upon supplying nearby cities and provisioning ships with food.

2. Transition stage (1840-1910)--staple products were increasingly shipped from the "western" areas (i.e., Indiana, Ohio, New York, etc.).

3. Present pattern (1910 on)--agriculture primarily involved in providing perishable type foods produced near point of consumption.

These three stages occurred as a result of other changes in the economic structure in the eastern United States. As ship transportation gave way to railroads, New England began to lose its comparative advantage of inexpensive water transportation. Thus, New England farmers turned to feeding local factory workers, and nonperishable commodities were imported from other areas of the country.

The agricultural and forestry sectors contribute less than one percent to total employment and, as Table 4.2 shows, a like amount to total earnings. Thus, from an economic viewpoint, these two sectors are relatively insignificant. But from a resource planning perspective, the fact that over 60 percent of the land area is in agricultural and forestry uses implies that a simple economic viewpoint does not suffice. To the extent that the land use mix is associated with water and related land resource management, as well as visual and environmental quality, agriculture and forestland must be a prime consideration in resource planning.

Table 4.2 also indicates the relative positions of the major economic sectors in the region. Although earnings in the manufacturing sector increased by almost 19 percent between 1962 and 1970, increases in the service-related sectors (service, government, finance, insurance, and real estate) increased by nearly 61 percent. As mentioned earlier, employment increases paralleled this growth in earnings.

The quality of the environment is tied very closely to the extent and type of economic activity being carried on in the region. In the colonial period through the 1800s, little concern was given to the waste by-products of production and consumption. Air and water were both considered to be free goods with no costs for their use. But as manufacturing grew and as population increased, the ever increasing amounts of waste became too concentrated to be assimilated into the environment. Once this stage was reached, air and water quality decreased. Individual towns in the region, however, took some action early. For example, in 1692, Massachusetts Bay Colony passed an ordinance which was entitled: "An Act for Prevention of Common Nuisances." This

TABLE 4.1 - EMPLOYMENT BY PLACE OF WORK, 1960, 1970. 1/

Employment Category	Boston Included				Boston Excluded			
	1960	1970	Change	Change (Percent)	1960	1970	Change	Change (Percent)
Agriculture	13,853	11,890	-1,963	-14.17	12,453	11,266	-1,187	- 9.53
Mining	970	518	- 452	-46.60	417	263	- 154	-36.93
Construction	95,848	105,091	9,243	9.64	27,987	31,833	3,846	13.74
Manufacturing	621,208	549,537	-71,671	-11.54	232,710	226,987	-5,723	- 2.46
Transportation	117,713	65,603	-52,110	-44.27	22,907	26,569	3,662	15.97
Wholesale	128,783	143,870	15,087	11.72	14,777	25,740	10,963	74.19
Retail	307,940	389,527	81,587	26.49	90,334	130,437	40,103	44.39
Finance, Insurance, and Real Estate	111,321	142,695	31,374	28.18	14,424	20,092	5,668	39.30
Other Services	342,451	515,454	173,003	50.52	78,707	127,709	49,002	62.26
Government	269,602	341,523	71,921	26.68	70,216	97,584	27,368	38.98
Total Employment a/	2,009,689	2,265,708	256,019	12.74	564,932	698,480	133,548	23.64

a/ Total employment figures will differ from census figures which are based upon place of residence.

1/ SOURCE: Employment data by place of work is from the Empiric Data File developed by John Green, ERS, USDA, for use in the SENE study.

TABLE 4.2 - POPULATION, EMPLOYMENT, PERSONAL INCOME AND EARNINGS BY INDUSTRY

Historical 1950, 1962 and 1970[1/]

ITEM	1950	1962[a/]	1970
Population, Midyear*	3,443,595	3,838,982	4,160,187
Per Capita Income (1967 dollar)	2,263	2,952	3,958
Per Capita Income Relative (U.S.=1.00)	1.10	1.14	1.14
Total Employment	1,351,554	1,500,971	1,723,537
Employment Population Ratio	.39	.39	.41
----------In Thousands of 1967 Dollars----------			
Total Personal Income	7,790,414	11,331,659	16,464,485
Total Earnings	6,233,458	9,203,213	12,967,402
Agriculture, Forestry & Fisheries	101,190	70,837	62,260
Mining	3,469	4,713	4,044
Contract Construction	378,933	509,735	824,967
Manufacturing	2,096,452	2,961,606	3,521,467
Transportation, Communication and Public Utilities	439,452	605,234	845,583
Wholesale and Retail Trade	1,307,039	1,681,912	2,284,519
Finance, Insurance, Real Estate	348,000	607,683	878,114
Services (includes government)	1,548,704	2,753,875	4,528,013

a/ Employment is for 1960.

* The geographical area represented by the OBERS report is larger than the Coastal Region.

1/ SOURCE: 1972 OBERS Projections, Regional Economic Activity in the U.S., Series E Population, Volume 5, Standard Metropolitan Statistical Areas, pp. 40 and 79.

act directed the selectmen of Boston, Salem, Charlestown, and other market towns to designate specific areas within those towns, wherein slaughter houses, tallow chandlers and curriers could operate. A butcher butchering livestock outside of the designated area would be liable to a fine. Water supply regulations also illustrate that the public recognized that degradation of water quality could have adverse impacts upon the public health. To minimize such degradation, laws were passed which permitted the control of upper watersheds which flow into water supply systems.

The water quality situation seems to be improving in most of the region's waters. The areas suffering most are primarily coastal harbors that still receive effluent overflows from sewage treatment plants and industrial plants. It is worthy to note one conclusion reached in the SENE report. The changing economic structure of the region, from manufacturing sector dominance to service sector dominance, implies that a relatively lower demand will be placed upon the water and related land resources. As a consequence, the ability of the region to meet environmental goals may be more easily attainable than one would expect. Economic growth objectives can be attained without sacrificing environmental standards.

4.2 SOCIO-ECONOMIC DATA

A. Projections and Relationship to OBERS[1/]

The OBERS projections are a nationally consistent set of projections for a region based on assumptions of national scope. State and local planners are encouraged to make their own projections based on known local conditions and compare them with OBERS.

The intentions of the OBERS projections are clearly described by the director of the Water Resources Council:

> The OBERS projections are intended as a planning tool, as a contribution to planning decisions. Wherever water and related land development problems may be solved by alternative levels of growth, through more or less resource development, full consideration should be given to such action, uninhibited by the projections contained in this report.
>
> The OBERS projections are not a goal. It is not intended that they be used as assigned shares, or quotas. They are not intended as a constraint on any region's economic activity. They do not express what is desirable or undesirable.[2/]

Some of the economic activity projections in this report were taken from OBERS projections, Series E,[3/] while others were developed by state and regional planning agencies.

Although direct comparisons with OBERS projections are not possible in terms of percentages, similar rates of growth are projected. The geographical area covered by OBERS extends outward from the Coastal Region's boundaries and includes some of the more densely settled areas in the Boston metropolitan area. When this factor is considered, the OBERS projections and those developed by the state and regional planning agencies do not significantly differ.

B. Employment

As noted in the previous section, OBERS data was gathered from an area slightly larger than the Coastal Region. For that reason, the discussions using OBERS data should be considered only as an indication of relative changes in employment and associated economic activities. Whenever possible, economic material will reflect the characteristics of the Coastal Region, per se. A comparison with OBERS will be undertaken, when appropriate.

Employment data used in OBERS are based upon employment by place of residence which do not necessarily reflect actual employment by place of work. For that reason, data was developed on employment by place of residence and by place of work.

TABLE 4.3 - COMPARISON OF EMPLOYMENT DATA

Item	Total Regional Employment[a/] 1960	1970
Employment by residence	1,621,228	1,853,757
Employment by place of work	2,009,689	2,265,708

a/ The employment data includes estimates for particular categories of employment not usually included in state gathering efforts.

SOURCE: Barber, Brian, and John W. Green, A Procedure for Determining Town Employment by Place of Work. ERS, USDA (Broomall, Pennsylvania, 1974).

As Table 4.3 shows, there are obviously a large number of employees who work in the region, yet live outside it. Because of this, an accounting of employment by place of residence may not give an accurate indication of the economic activity within a particular region. The controlling factor in such analysis is the location and size of the employment center within the Coastal Region, and its sphere of influence exceeds the boundaries of the region. If the region included all the bedroom communities in the Boston sphere of influence, we would see the two categories of employment converging.

C. Income

The Coastal Region enjoys a per capita income that has consistently been above the national average. In 1962, the per capita income in the region was $2,952 and increased 34 percent by 1970 to $3,958 (1967 dollars). The average per capita income in the United States in those two years was $2,577 and $3,460, respectively. Thus, in 1962, the region enjoyed a per capita income 14.5 percent above the national average. In 1970, the margin was 14.4 percent. Projections to 1990 show an increase in per capita income. Expected increases in leisure time, together with increases in disposable income, will result in increased recreational demands and, indirectly, an increased demand upon water and related land resources.

D. Urban Centers and Their Influences

As illustrated, Boston is clearly the dominant urban center in the Coastal Region and for most of New England. Boston enjoys a highly diversified economy, being the center for government, professional, financial, insurance, real estate, business and repair services, wholesale and retail trade, printing and publishing, and technical manufacturing.

The other major urban center in the region is the Fall River-New Bedford Standard Metropolitan Statistical Area (SMSA). This center is engaged primarily in manufacturing and is not nearly as diversified as the Boston area. This limited diversification is reflected in the lower per capita income of this urban center, as the economic structure changes from manufacturing to service-related industries. For example, in 1950, the per capita income of the Fall River-New Bedford area was 2 percent above the national average but, in 1969, it was 6 percent less. Projections suggest that this same disparity will exist in 1990 and worsen in 2020.[4/] This trend results from the continuing relocation of manufacturing firms out of the region.

E. Transportation

The Coastal Region is fortunate to have a diversified and relatively efficient transportation network. There are numerous federal, state, and local highways in the region with U.S. Routes 1 and 3 running north and south, as does I-95. State Routes 9 and 2 run in a primary east-west direction, while 138 runs south from Boston through Taunton and Fall River to the Providence, Rhode Island area. Interstate Route 495 forms an outer beltway which connects New Hampshire and Rhode Island. The Massachusetts Turnpike (I-90) runs west from Boston to the New York stateline. State Route 128 is the inner beltway around Boston which was designed to provide less congested driving around the periphery.

Railroad service is excellent and serves most of the region. Tied closely to this is the rail mass transportation system, considered to be one of the best in the country. Waterborne shipping systems are also significant. Boston serves as the major port in terms of cargo tonnage of foreign and intercoastal shipping activity. New Bedford is next in size. Logan International Airport, located immediately north and adjacent to Boston harbor, is the center for air transport and air freight. In addition to international and national airlines, Logan Airport is also served by regional airlines that fly to other areas of the state and to municipal airports in other nearby states.

4.3 AGRICULTURAL AND FOREST RESOURCES AND RELATED ECONOMIC ACTIVITY

A. Agriculture

Major Crop and Livestock Enterprises, Volume and Value of Farm Production[5/]

The Coastal Region, like the state, has a well balanced agricultural sector but differs in that the crop and related commodities contribute more than the livestock side. In this region, crops contribute 53.4 percent, forestry products contribute .2 percent, and livestock contributes 46.4 percent. As Table 4.4 shows, the southeast subregion produced more than 78 percent of the value of agricultural products, followed by the northeast subregion share of 17 percent, and the Cape Cod and Islands 5 percent.

The major livestock enterprise in the Coastal Region is dairying which contributed approximately $11,643,000 (26.8 percent of total agricultural receipts) in 1974.[6/] Other livestock and poultry enterprises contributed $8,508,000 (19.6 percent).[7/]

As mentioned previously, cropping enterprises in the region contributed 53.4 percent of total agricultural marketing receipts. These enterprises are broken down into the following categories: greenhouse and nursery, vegetables, cranberries, fruit, and other crops. Cranberries contributed approximately $10 million (4 percent) toward the total agricultural receipts of $202 million in 1975. The fact that nearly all of the state's cranberry production takes place in the southeast subregion justifies a detailed discussion of this crop.

As most Bay Staters are aware, southeastern Massachusetts is a major cranberry producing region in the nation. Plymouth County accounts for over 80 percent of the state's production. Table 4.5 summarizes significant data on cranberry production between 1966 and 1976. As the table shows, the value of production exceeds $10 million which equals a gross value per acre in excess of $1,100.

TABLE 4.4 - VALUE OF AGRICULTURAL PRODUCTION, PRODUCTION EXPENSES, NET VALUE, AVERAGE NET VALUE PER FARM, 1974.[1/]

Subregion	Value of Agricultural Product	From Crops[2/]	From Forestry Products	From Poultry	From Livestock	Production Expenses	Net Receipts-Expenses	Number of Farms	Average Net per Farm
	Thousands of Dollars								
Northeast									
All farms	7,415	4,258	37	899	2,221	6,543	872	269	3,242
Farms with sales over $2,500	7,258	4,180	33	880	2,165	6,355	903	166	5,440
Southeast									
All farms	34,659	17,370	63	3,746	13,480	30,085	4,574	1,165	3,926
Farms with sales over $2,500	34,115	17,102	54	3,704	13,255	29,440	4,715	775	6,084
Cape Cod & Islands[3/]									
All farms	2,172	1,996	5	5	166	1,803	369	146	2,527
Farms with sales over $2,500	2,097	1,946	4	4	143	1,699	398	80	4,975
Coastal Region Total									
All farms	44,246	23,624	105	4,650	15,867	38,431	5,815	1,580	3,680
Farms with sales over $2,500	43,470	23,228	91	4,588	15,563	37,454	6,016	1,021	5,892

1/ Basic data from 1974 Agricultural Census, with adjustments to those counties which are situated in one or more regions.
2/ Included in the crop category are crops, vegetables, hay, and nursery products.
3/ Nantucket Island is not included.

TABLE 4.5 - CRANBERRY ACREAGE, YIELD, PRODUCTION, UTILIZATION, PRICE AND VALUE, MASSACHUSETTS 1966-1976

Year	Acres	Yield Per Acre (Barrels)	Production[1/] (1000 BBLS)	Total Sales	Percent of Production Sold	Season Average Price Per Barrel[2/]	Value of Total Sales ($1000)
1966	11,200	68.6	768	713	92.8	$15.20	10,838
1967	11,200	51.2	573	503	87.8	14.90	7,495
1968	11,100	59.5	660	622	94.2	15.40	9,579
1969	11,200	67.4	755	749	99.2	15.40	11,535
1970	11,100	86.2	957	817	85.4	11.90	9,822
1971	11,100	96.6	1,072	680	63.4	15.70	10,676
1972	10,900	75.1	819	770	94.0	12.60	9,702
1973	10,900	82.7	901	809	89.8	13.60	11,002
1974	10,900	85.5	932	658	70.6	10.70	7,041
1975	10,900	72.0	785	670	85.4	12.10	8,107
1976[3/]	10,900	85.8	935	850	90.1	13.10	11,135

1/ Differences between production and the total of fresh sales and sales for processing are economic abandonment.

2/ Equivalent return at first delivery point.

3/ 1976 data taken from New England Crop and Livestock Reporting Service, Statistical Reporting Service, U.S. Department of Agriculture, Massachusetts Crop Summary, July 11, 1977.

SOURCE: 1976 Massachusetts Agricultural Statistics, NECLRS, Statistical Reporting Service, USDA and Massachusetts Department of Agriculture (Boston). Page 15.

In 1975, a study[8/] on current and projected water use in cranberry production was published by the Economic Research Service (ERS) as part of the Massachusetts Water Resources Study. The conclusions reached in the 1975 study were that cranberry acreage would decline 44 percent by 1990, and water use in cranberry production would decline by more than one-half by 1990.

However, a major change in the marketing structure occurred when a supply control agreement was accepted nationally and growers received individual quotas. An allotment percentage is applied to individual base quantities to determine a grower's market allotment. The obvious impact of such a market quota system is price stabilization, which has subsequent stabilizing impacts upon total cranberry acreage. As a result, cranberry acreage in Massachusetts has remained for the past 5 years at 10,900 acres. For an 11-year period, acreage has decreased 300 acres, a mere 2.7 percent.

Estimating per acre water use is extremely tenuous at best. Factors of weather, grade of bog, and pumping facilities in some bogs permitting reservoir return systems all have significant impacts upon the amounts of water required. Utilization of sprinkler irrigation systems has significant impact on water use. As a result, certain assumptions were utilized to determine water use per acre. From these assumptions, ERS developed an average acre requirement for water which amounted to 2.86 million gallons.[9/] Taking the estimated per acre water requirement and multiplying that times the projected cranberry acreage for 1990 of 10,000 acres, a revised total water need of 87,741 acre-feet for cranberry production was determined. In comparison to present water use, the 1990 figure is approximately 11 percent less. From a water supply perspective, potential problems to cranberry production areas appear to be minimal.

Employment and Income

As mentioned in Section 4.1, in comparison with the total Massachusetts economy, the agricultural sector is relatively small with gross cash receipts of approximately $202 million in 1975. The agricultural receipts in the Coastal Region contributed approximately 22 percent to the state total or $44,246,000. Taking the total cash receipts and subtracting production expenses of $38,431,000 results in net income of $5,815,000. Dividing this figure by the total number of farms in the region results in an average farm net income of $3,680. When only those farms with sales over $2,500 are examined, the result is an average net income of $5,892, nearly 63 percent higher than the all farm average (See Table 4.4).

When discussing employment in the agricultural sector, it should be noted that certain problems exist when such data is compiled. Most employment data in the state is generated through the Massachusetts Division of Employment Security which collects data for employment covered under the statutes which charter it. These charters are primarily employment

compensation, job referrals, and manpower planning agencies. Although expanded in recent years, the historical data series includes only employment covered by employment compensation acts which amounts to approximately 80 percent of total employment.

Barber and Green,[10/] in their work on the SENE Study, estimated the remaining 20 percent of the data for the Coastal Region. The Division of Employment Security collects data approximately for 50-70 percent of the total employment in agriculture, fisheries, and forestry. The remainder were estimated. In 1970, total employment for the agricultural, fishery and forestry sector amounted to 11,890 individuals which represented less than one percent of the total labor force. As mentioned in Section 4.1, agricultural income for this same period also was less than one percent. These percentages were approximately the same for 1975.

Economic Factors Affecting Agriculture

One of the most obvious signs of poor economic performance of agricultural enterprises is that between 1969 and 1974, agricultural land in the state declined 83,082 acres from 700,578 acres to 617,496 acres, an 11.9 percent decline. Likewise, the number of farms decreased by 708 or a drop of 12.4 percent. The Coastal Region has experienced a similar decline. In 1969, there were 1,846 farms, compared with 1,580 in 1974, a decline of 266 or 14.4 percent. Likewise, acreage in farms declined by 16,146 acres from 172,257 to 156,111 (a 9.3-percent drop).

There are a number of factors which have contributed to the decline of agriculture in the state and in the region. Probably the most significant factor is farm profitability. In 1974, 98 percent of the agricultural receipts were accrued by only 65 percent of the farms (that category of farm with over $2,500 in annual sales) in the Coastal Region. There were 559 farms with sales of under $2,500 a year. When sales, income, and expenses are combined, these 559 farms had an average loss of nearly $1,750. From this point alone, it would seem reasonable that many of these 559 farms on nearly 23,000 acres will be going out of production, unless subsidized by off-farm income.[11/]

Many factors affect profitability in the agricultural sector: rising labor and capital equipment costs, shortage of labor, alternative employment with greater pay and shorter hours, taxation, lack of market output infrastructure (e.g., slaughtering houses, processing plants), nuisance laws, higher transportation rates than in competing regions, climate, and land.

The Governor and the Commissioner of Agriculture, in viewing the historical decline of the state's agricultural sector, issued "A Policy for Food and Agriculture in Massachusetts,"[12/] setting forth a policy to preserve agricultural land. The statewide trend, from an agricultural perspective, is rather alarming: a decrease from 35,000 farms to a little more than 6,000 since World War II. And during the same period, farm land decreased from over 2 million acres to a little more than 700,000.

As of 1976, Massachusetts was importing 85 percent of its food: 97 percent of its meat, 70 percent of its eggs, 80 percent of its milk, and 90 percent of its potatoes.[13/] It should be noted, however, that about 25 percent of the state's total food requirements must be supplied from sources outside the state.[14/] Of this 25 percent, 15 percent of the total food purchases cannot be produced in Massachusetts under any reasonable technical or cost assumptions. These are such foods as citrus and tropical fruits, sweet potatoes, rice, etc. The remaining 10 percent is in the form of fresh fruits and vegetables imported from other regions during those seasons when production is not possible in Massachusetts. Physically, then, Massachusetts could potentially produce 75 percent of its total food requirements, whereas today, the state is only producing 15 percent.

There is no question that a substantial in-state market for food exists, but it appears that economic conditions are such that Massachusetts farmers are unable to competitively supply this market. As a result of the high import demand for food commodities, Massachusetts residents pay from 6-10 percent more for their food than the national average.[15/] As a consequence, the food prices in Boston are the fourth highest of the 38-major American metropolitan areas. Much of these higher costs have been heightened by high transportation rates and a lack of storage facilities in the state.[16/]

Tied very closely to the decline in agriculture is the manner in which land resources are allocated to development. Most of the local zoning ordinances zone agricultural land as low density development; at best, an inefficient use of a scarce resource. What is necessary is an educational effort, whereby local zoning ordinances would be more flexible and lessen the pressures of development on agricultural land. Without such changes, there will be no incentive not to develop farmland.

It should be pointed out that there are only two food crops in the state where production exceeds consumption: sweet corn and cranberries. As a result, it may be necessary to introduce future programs, whereby incentives could be generated to produce a given crop or a combination of crops (land, climate, capital, and management permitting). Such a program could involve subsidies (e.g., a guaranteed outlet at a guaranteed minimum price).

B. FOREST RESOURCE

Extent and Nature of the Resource

After more than three centuries of settlement, forests occupy about 908,000 acres or 54 percent of the 1,680,000-acres in the Coastal Region.[17/]

Trees occupy the upper story of the forest resource, while shrubs, forbs, and grasses occupy the lower stories. These lower stories, along with a

host of other organisms present on the forest floor, serve vital functions in the forest ecological system.

A forest is an association of tree species. The tree species associated on a specific land area are a function of soils, sites, climate, aspect, and cultural activities. Figure 4.1 shows the general association of trees in the region. Table 4.6 shows estimates on tree volume and size classes in the region.

Utilization: Kind, Volume, and Value of Output

The forest resource provides goods and services that benefit the region's economy and environment. These goods and services can be grouped as wood products, water, forage, wildlife, and recreation.

Wood Products[18/]--The annual sawlog harvest is approximately 11.9 million board feet, valued at $1,023,400. The majority of the sawlogs harvested are white pine. Other roundwood products are composed primarily of fuelwood and some pulpwood. Approximately 19,000 cords are harvested annually, valued at $380,000. Total roundwood harvest annually approximates 2 million cubic feet.

Water[19/]--Forestland is a source of good quality water. Precipitation falling on forestland is used by the vegetation, evaporated, stored in the soil, or leaves the watershed as streamflow. Streamflow is watershed yield. Forestland in the region yields 1.66 million acre-feet (542 billion gallons) annually, valued at $4.1 million.

Forage[20/]--There is very little grazing of livestock on forestland. Because of the urban nature of the region, it is unlikely that grazing will ever be an important use of forestland.

Wildlife[21/]--Forestland is valuable wildlife habitat. Each 100 acres of well managed eastern hardwood forest can support a fall population of: three turkey, three deer, 25 grouse, 50 rabbit, and 100 squirrel for a total of 180 game animals and over 200 fur animals.

Recreation[22/]--Recreational activities can be divided into two broad categories, general and specific. General recreation includes activities attractive to the majority of outdoor recreationists and which generally require the development and maintenance of convenient access and adequate facilities. Activities include picnicking, swimming, sightseeing, camping, and hiking.

Special recreation includes activities for which opportunities, in general, are limited, intensity of use is low, and often a large personal expense is incurred by the user. Activities include hunting, fishing, backpack camping, canoeing, and snowmobiling.

FIGURE 4.1

FOREST TYPE MAP

LEGEND

- WHITE & RED PINE
- PITCH PINE
- OAK-PINE
- OAK-HICKORY
- ELM-ASH-RED MAPLE
- NON-TYPED



5 0 5 Miles

1-12,793

TABLE 4.6 - NET VOLUME OF GROWING STOCK ON FORESTLAND, BY SPECIES AND TREE CLASSES, MASSACHUSETTS, 1972

Species	Net Volume (Million Cubic Feet)
White Pine	265.4
Pitch Pine	26.9
Hemlock	28.2
Other Softwoods	62.1
Total Softwoods	352.6
Select White Oaks	29.6
Select Red Oaks	75.4
Other Oaks	65.4
Hickory	14.5
Sugar Maple	14.7
Soft Maples	110.5
Sweet Birch	9.6
Yellow Birch	9.4
Paper Birch	11.5
Beech	6.3
White Ash	12.0
Black Cherry	11.2
Aspen	6.5
Elm	2.4
Other Hardwoods	3.9
Total Hardwoods	382.9
All Species	735.5
Sawtimber	368.7
Poletimber	366.8
All Classes	735.5

There are approximately 3.87 million visitor days of general recreation use on forestland valued at $7.7 million, and 6.74 million visitor days of special recreation valued at $32.9 million annually within the Coastal Region.

Current Growth

The forest resource in the Coastal Region is underutilized in terms of its potential to produce wood products. The usual measure of this is the growth-cut relationship. Growth is the volume of wood added annually to the inventory of wood, and cut is the volume of wood cut annually from the inventory.

Growth averages about 50 cubic feet per acre annually while the cut for wood products averages about 5 cubic feet per acre annually. The growth to product cut ratio of 10:1 indicates that the cut could be increased substantially without touching the inventory base.

The growth-cut ratio does not reveal necessary factors about the resource such as quality of wood, the economic availability of wood, the volume of wood cut but not used for products, and the volume of wood offered for sale by the landowner. The critical factor appears to be that only 50 percent of the forestland is available for wood products. Chapter 5 discusses land ownership and landowner attitudes in more detail.

Employment and Income in Primary and Secondary Wood Processing

The primary forest product industry--those companies manufacturing wood products from logs and bolts--is almost exclusively made up of sawmills. No pulp, cooperage, or veneer industries operate in the region. Excluded here are companies or individuals manufacturing fuelwood from logs and bolts. In 1975, 33 commercial sawmills were located in the region.[23/] To supply mills with logs and bolts, 29 logging contractors were located in the region.

In 1975, approximately 100 people were employed in the sawmill industry.[24/] Employee earnings in the sawmill industry are estimated at $700,000.

The secondary forest product industries--those companies using wood which has undergone some previous manufacturing process and which use wood exclusively or partially in a further manufacturing process--is quite extensive in the region. These industries include such diversified manufacturing processes as hardwood dimension and flooring, millwork, structural wood members, wood boxes and shook, wood furniture, paper, and paperboard. In 1975, approximately 5,000 people were employed in these wood-based industries.25/ Employee earnings in these industries are estimated at $5 million.

Employment in wood-based industries is shown in Table 4.7.

TABLE 4.7 - EMPLOYMENT IN WOOD-BASED INDUSTRIES, 1974-75

Major Group	Employees
24 - Lumber and Wood Products, except Furniture	2,000
25 - Furniture and Fixtures	1,000
26 - Paper and Allied Products	2,000

Economic Factors Affecting Forest Resource

Forestland is a part of a finite land base. Changes to the land base affect the forest resource. These changes could add or subtract acreages to the forestland base, could increase or decrease the desired species composition, age and size classes of the forest stand, and increase or decrease the economic and environmental benefits derived from the forest resource. An estimated 5,000 acres of forestland has been converted annually to other land uses, primarily urban land uses.

The Coastal Region still boasts an extensive forest resource despite the pressures of a large population, and the attendant large-scale street, road, and highway network; and residential, commercial, and industrial development. The fact that forested land occupies fifty-four percent of the land area speaks well for the potential to make more complete use of the forest resource and the benefits that the forest resource can provide.

The Coastal Region by nature of the metropolitan character is not conducive to forest management as the term commonly implies. The high population density; the high level of development to support the population; the thousands of owners, most of whom own small acreages; the scattered ownership pattern; the diversity of owners' attitudes toward forest property; and the lack of diversified markets for wood products, singly and in combination inhibit an efficient forest management program.

Land to remain in forest cannot effectively compete with land that is to be developed for other more economically advantaged uses. Similarly, the use of forestland for the traditional output of commercial wood products cannot compete effectively with the desires and needs of the people for their own solitude, well being, or for whatever nonmonetary reasons they own forestland.

4.4 OTHER SIGNIFICANT ECONOMIC SITUATIONS

A. Tourism

In 1974, tourism in Massachusetts generated over $1.15 billion and contributed approximately 3.5 percent of the total income received in the Commonwealth from all sources. Employment in the tourism industry amounted to more than 74,400 year-round jobs.

A report entitled "The Economic Impact of Tourism on the Commonwealth of Massachusetts" stated that: "there is probably no industry of any consequence to the Commonwealth - and certainly none as important as the tourism industry - about which so little is known."[26/] There are a number of possible reasons for this lack of information:

1. It is an industry with a very large number of enterprises - from giant hotels to part-time, one-person businesses;

2. customers are not easily identifiable, yet amount to some 33 million per year;

3. it is an industry whose product is service, not commodity;

4. it is an industry whose services are vastly diverse.

The report noted a rather interesting phenomenon concerning whether other New England states are competitive with Massachusetts or if the region as a whole attracts the people. If the latter is the case, then the relationship of the New England states could be considered supportive, not competitive. The report concluded that visitors tend not to come to both--visitors generally come to Massachusetts or to one or more of the other New England states.[27/]

Although the report is a preliminary study, a table of total income generated by tourism in Massachusetts was developed. Table 4.8 summarizes the findings.

Tourism plays a rather significant role in the economy of Massachusetts. If we look at the Coastal Region with its vast array of beaches, resort areas, and other tourist facilities relative to the rest of the state, it can be concluded that a rather large proportion of this total income is generated in the region. According to Professor Norman G. Cournoyer, University of Massachusetts, 1975 expenditures by non-Massachusetts travellers were $958 million. The eastern counties of the state received nearly 92 percent of this total. Deleting Essex and Middlesex Counties, the percentage drops to 71 percent. Thus, with the most conservative estimate, the Coastal Region receives nearly three-fourths of the total tourist expenditures by non-Massachusetts residents.[28/]

TABLE 4.8 - TOTAL INCOME GENERATED BY TOURISM IN MASSACHUSETTS

ITEM	Accommodations					
	Commercial Lodging	Own Cabin, Trailer	Friends and Relatives	Other	Day Trip	Total
	(Thousand Dollars)					
Purpose of Trip						
Business	199,381	264	38,272	4,261	12,565	254,743
Personal Business	108,456	58,321	38,059	2,581	12,305	219,723
Convention	14,622	0	106	5,330	357	20,415
Visit Friends and Relatives	70,288	2,902	192,110	22,501	15,249	303,050
Recreation, Sightseeing, Entertainment	287,992	48,935	17,785	5,186	9,981	369,879
TOTAL	680,739	110,422	286,332	39,861	50,457	1,167,809

SOURCE: The Economic Impact of Tourism on the Commonwealth

NOTE: "Other" includes nights on a cruise, boat, or other special facilities.

Totals may not add, due to rounding.

B. Commercial Fishing

Commercial fishing at one time was a major employer and income-earner in the Coastal Region, especially the southeast subregion. Table 4.9 summarizes the catch and value of the catch from 1930 to 1970.

TABLE 4.9 - CATCH AND VALUE, COMMERCIAL FISHING
MASSACHUSETTS, 1930-1970

Year	Catch[1/] (1,000 lbs.)	Value of Catch[2/]
1930	442,474	$36,522,422
1940	510,938	38,903,704
1950	591,188	49,837,408
1960	480,421	43,944,988
1970	282,200	41,485,507

1/ Includes haddock, Atlantic Ocean perch, sea herring, cod, flounder, and northern lobster.
2/ Adjusted to constant 1967 wholesale dollars.
SOURCE: New England Economic Almanac, Federal Reserve Bank of Boston, (Boston: 1971), p. 26.

As Table 4.9 shows, there has been a steady increase in the unit value of the catch while the weight of the catch has decreased precipitously (41.3 percent decline since 1960). With the 200-mile ocean boundary recently imposed by the U.S. Government, less intensive fishing by foreign flagships has resulted in an increased catch for domestic ships.

4.5 RELATIONSHIP BETWEEN ECONOMIC SITUATIONS AND NED SPECIFIC COMPONENTS

A. Study Concern--Land Use

The NED specific components are formulated so that agricultural land moving into other uses will be minimized. Due to the higher incomes possible from alternative employments, agricultural land is decreasing because of low returns to the agricultural enterprise. This is a result of interregional competition, land prices, tenure and land holding philosophies, physical characteristics of the land (soils, slopes, growing season length, etc.), and marketing and processing infrastructure. It is obvious that a laissez-faire market policy is not conducive to the maintenance of agricultural land. Thus, a public policy which would either artificially (subsidize) or directly impact the agricultural market structure is necessary, if a viable agricultural sector is to be

retained. To that end, the General Court of Massachusetts passed a development rights bill to enable local governments to purchase development rights to agricultural land and later passed a measure establishing a state program to acquire these rights. These programs could potentially lower entry costs and tax costs, and change tenure and land holding to philosophies that are more conducive to agricultural operations. The long term application of these programs, if adequately funded, should enhance the potential for economic growth of the agricultural marketing and processing infrastructure.

In discussing the forestland situation with respect to its NED specific components, similar economic conditions preclude optimism for obtaining objectives. Like the agricultural land resource area, the forestland area suffers from some adverse economic conditions which are due to interregional competition; tenure and land size holding patterns; reasons/philosophies for owning forestland; and minimal availability of primary, secondary, and tertiary wood processing firms. In addition, the dearth of economic return and cost information inhibits the development of a management program justified on economic grounds. Thus, to attain the NED specific component of increased utilization of the forest resource, requires that an approach be formulated, whereby forestland owners can see the "value" of increasing the utilization of the forestland resource.

B. Study Concern--Inland Flooding

The specific NED components with respect to the flooding study concern involve the minimizing of flood damage in the region and accomplishes the objectives by structural measures, flood proofing existing property, guiding development away from flood prone areas, and protecting wetland flood storage areas from filling or development. With respect to the present economic situation and the NED components, given the present enactments of both federal and state statutes, the attainment of the components is, from an economic point of view, quite realistic.

C. Study Concern--Wetlands

The NED components for the wetland resource area consist of protecting wetland flood storage from filling, protecting flood prone areas from development, and increasing wetland recreation. The attainment of these components, given present local, state, and federal enactments, seems economically feasible.

D. Study Concern--Recreation

According to the state outdoor recreation report, the demand for recreational needs exceeds the available supply and, thus, the NED specific component is to increase public access to outdoor recreation resources, and to increase the recreational opportunities so that the divergence between supply and demand will be minimized. From an economic perspective, attaining the NED components is not an unwarranted goal. Obviously, if present state

financial problems were to continue to exist at the level of the last three years, the attainment would be slow. Thus, economically, the conditions of local and state finances will determine what proportions of the components are attained. The question comes to how much can the state affort to budget towards attaining the recreation objective.

4.6 ENVIRONMENTAL SITUATION

A. Coastline and Tidewater

One of the most important natural resources of the Coastal Region is the nearly 1,200 miles of saltwater shoreline. The Massachusetts coast is a study in varied contrasts. The northernmost area near Rowley and Ipswich Rivers estuaries is an enormous tidal flat which is excellent wildlife habitat and site of the Parker River National Wildlife Refuge. Further south, the names Rockport and Marblehead evoke visions of this rugged rockbound section of shore. South of this, Massachusetts Bay has a shoreline which is dominated by urban development which ends right at the waters' edge behind sea walls, jetties, and the busy waterfront of Boston Harbor. The area from Scituate to the Cape Cod Canal is best typified by its towering cliffs of silt and sand, which sometimes slide into the sea with disastrous results for the development which stands atop the cliffs. The area inside the "arm" of Cape Cod boasts a fairly flat topography with some areas having a horizontal tidal range of over a half-mile. The outside arm of the Cape is subject to the undiminished fury of the North Atlantic Ocean. Severe storms and constant pounding by the waves result in a large movement of sand material from some areas and the building up of other areas. The South Shore of Cape Cod has some of the most densely developed residential areas on the Cape. This is a section which has an exposure to the ocean but benefits to some extent from the sheltering influence of Martha's Vineyard and Nantucket Islands. The coastline ringing Buzzards Bay is packed with coves, bays, and inlets which have been developed by people seeking a water view. The orientation and configuration of Buzzards Bay funnels the effects of hurricane-driven tides; and high water over 16 feet above mean sea level is not unheard of in this area. The coastline of the offshore islands consists of sandy beaches and high cliffs, the most famous being the fragile Gay Head cliffs at the western edge of Martha's Vineyard. The islands have a number of quaint harbors which seem to add to the natural beauty of the region.

An active program is underway, directed by the Massachusetts Office of Coastal Zone Management (CZM), to inventory, assess, and protect the coastal resources of the state. The CZM program has benefited from the inputs of a large number of citizens. Each community along the coast has a representative to CZM. There have been some problems with communities being reluctant to give up their "home rule" for the greater good of the region, but overall, the CZM program seems to be successful in eliciting the concerns of the people in the area regarding their desires for the future management of the coast.

Preliminary findings of the CZM inventories indicate an overwhelming desire to preserve the coastal area as a region of natural beauty. Some of the most serious problems perceived by local representatives include the possibility of oil spills endangering fish, wildlife, and the tourist industry; unsightly shoreline development including shoddy beach cottages, oil tank farms, and garish commercial development; uncontrolled growth which threatens to destroy the quaint charm of the region; and on the Cape and Islands, the boom or bust nature of the important tourist industry. Overall, throughout the Coastal Zone, there seems to be an awareness of the importance of protecting the environmental factors which make the area unique, pleasant, and upon which the economy of much of the area is based.

B. Land

Landforms in the region are a result of the geologic history of the area. Glacial activity during the Pleistocene ice age was the prime factor in shaping the Coastal Region as it is today. The low rolling hills, streams with flat gradient, and the abundance of wetland areas can all be attributed to the influence of the last glacial period. The topography of the area is, of course, one of the most important factors in the economy of the region. Tourists by the millions are attracted to the natural beauty of the Massachusetts seacoast. The appeal of Cape Cod and the offshore islands draws visitors from widely dispersed areas of the country. The quaint charm of small village centers is often overshadowed by the natural beauty influenced by the juxtaposition of land masses, wetlands, and the land-sea interface.

Topography has also been an important determinant of location for one of the most important agricultural commodities in the state--the cranberry. The shiny red berry is one of the few agricultural commodities of which Massachusetts is a net exporter in large quantities. Cranberry culture requires a combination of climate and topography which are merged in the southern portion of the Coastal Region. The many wetland areas left by glacial activity were natural choices for enhancement for cranberry growing. The abundance of groundwater and the wetland areas that could be managed for agricultural water storage further increased the potential of the area. The well-maintained bogs with their seasonal changes in vegetative characteristics have added greatly to the aesthetic and visual quality of the region. Another related function which the bogs have served is to keep significant amounts of land area as open space, rather than forest or brush land. This has resulted in keeping the landscape varied and visually interesting.

The region's wetlands have also been a source of enjoyment to residents and visitors. The area has over 159,500 acres of inland wetlands which provide storage for floodwaters, maintain summer flows in the streams, serve as fish and wildlife habitat, and enhance visual quality. In the 1960s, residents and government began to realize that wetlands were being lost at an alarming rate. Developers were buying parcels of cheap swampland, hauling in fill and constructing shopping centers and housing

tracts, and then departing to let the new owners be confronted with the problems of highwater tables, settling and cracking foundations, failing septic systems, periodic flooding, and a host of related nuisances. In addition, it became apparent that loss of natural flood storage in the wetlands was causing downstream flood peaks to increase, resulting in increased financial losses due to flooding. The loss of wetland wildlife habitat and its effect on certain species was not as dramatic as the other problems but was very real to knowledgeable observers.

In some cases, town governments themselves were unwitting co-conspirators in the loss of wetlands. Zoning regulations encouraged developers to build in many wetlands zoned for industrial or commercial uses. Some towns decided that these "useless swamps" would serve as good municipal dump sites. Similar problems with wetland losses occurred in the salt-water wetland areas. There, fill was being placed in prime wildlife breeding areas to provide more high-value real estate.

To counter the loss of wetlands, pioneer legislation was introduced by Representative Francis Hatch. Even to this date, subsequent wetlands legislation is often referred to as "the Hatch Act" even though the original Hatch Act has seen many changes through the years. In addition to restriction laws, Massachusetts has a very active wetlands acquisition program. Two key state agencies involved are the Massachusetts Division of Forests and Parks and the Massachusetts Division of Fisheries and Wildlife. Cities and towns are also involved in wetland acquisition. Cost sharing funds for such community acquisitions are provided from the Massachusetts Self-Help Fund (General Laws Chapter 132A, Section 11) administered by Massachusetts Division of Conservation Services. The various wetland restriction, control, and conservation measures now available to protect wetlands are described in detail in Chapter 5.

C. Population Distribution and Land Use Aspects

The population within the Coastal Region was about 2,900,000 in 1975. With a total land area (excluding water and wetlands) of 1,500,693 acres, or 2,345 square miles, the population density was approximately 1,237 persons per square mile (or 1.9 persons per acre). Most of the population, as can be seen in Table 4.10, is concentrated in north and south subregions with respective population densities of 4.6 persons per acre and 1.3 persons per acre.

In discussing water and related land resources, simple analysis of permanent population data is not sufficient, especially for the Cape Cod subregion. As Table 4.11 shows, the seasonal population, when added to the permanent population for the Cape, more than triples the total population figure. Such increases become very significant in terms of planning for land use, water supply, and demand for public services.

TABLE 4.10 - POPULATION, LAND AREA,[1/] AND POPULATION DENSITIES

Area	1950	1960[2/]	Percent Change 1950-1960	1970	Percent Change 1960-1970	1975	Percent Change 1960-1975
Northeast							
Population	1,588,530	1,606,923	1.16	1,648,453	2.58	1,634,966	- .82
Land Area (AC)	387,241	384,829	- .62	382,417	- .63	382,417	0.00
Densities							
Persons per acre	4.10	4.18	1.95	4.31	2.86	4.28	- .69
Persons per sq. mi.	2,625	2,672	1.79	2,759	2.91	2,736	- .83
Southeast							
Population	751,370	915,581	21.86	1,067,470	16.59	1,125,464	5.43
Land Area (AC)	860,816	855,334	- .64	849,853	- .64	849,853	0.00
Densities							
Persons per acre	.87	1.07	22.99	1.26	17.76	1.32	4.76
Persons per sq. mi.	559	685	22.54	804	17.37	848	5.47
Cape Cod & Islands							
Population	51,353	76,129	48.25	103,447	35.88	141,110	36.41
Land Area (AC)	355,073	353,348	- .49	351,623	- .49	351,623	0.00
Densities							
Persons per acre	.14	.22	57.14	.29	31.82	.40	37.93
Persons per sq. mi.	92.56	137.89	48.97	188.29	36.55	256.84	36.41
Total Coastal Region							
Population	2,391,253	2,598,633	8.67	2,819,370	8.49	2,901,540	2.91
Land Area (AC)	1,603,130	1,593,511	- .60	1,583,893	- .60	1,583,893	0.00
Densities							
Persons per acre	1.49	1.63	9.40	1.78	9.20	1.83	2.81
Persons per sq. mi.	955	1,044	9.32	1,139	9.10	1,172	2.90

1/ Land area excludes water acreage. 2/ Land area for 1960 extrapolated from 1950-1970 trend.
SOURCE: Population figures from Table 2.2. Land acreage from MacConnell, et al.

TABLE 4.11 - PERMANENT AND SEASONAL POPULATION COMPARISONS, CAPE COD STUDY AREA - 1960, 1970, and 1975

ITEM	1960	1970	1975
Permanent Population	70,286	96,656	128,000
Permanent Plus Seasonal Population	242,817	323,000	382,000
Percent Difference	345.47	334.17	298.44

When both the permanent and seasonal population are considered, the 1975 density in the Cape Cod area increases from .456 persons per acre (2.2 acres per person) to 1.36 (.73 acre per person), an increase of over three times.

Naturally, these differences in population density present different problems and objectives from an environmental standpoint. In addition, the sparsely populated towns are able to see the results of poor planning or rapid growth in neighboring high-density communities and are encouraged to guide their future growth. The Massachusetts Natural Resources Planning Program provides for local communities to inventory their present natural resources, to evaluate those resources against established guidelines, to determine the consequences of proposed actions on the natural resource base, and to plan the most acceptable future course of action to maintain or impove the community's selected level of environmental quality. Over half of the Massachusetts communities participating in the Massachusetts Natural Resources Planning Program are located within the Coastal Region. This indicates the relatively high interest on the part of local people in conserving their natural resources and insuring that future growth is compatible with the desired community environmental quality.

As Table 4.10 shows, the Cape Cod and Islands subregions area showed the greatest growth rates in population and population densities between 1950 and 1970. The reason for this trend is primarily because of the increase in seasonal populations. Future growth is expected at a much slower rate because of rather strong land use planning legislation that has been enacted in the last few years. Between 1970 and 1975, the northeast subregion showed an actual decline but, when it is remembered that Boston thoroughly dominates the demographic characteristics of the area, the trend excluding Boston is not atypical of the rest of the region.

It is important to note that from an environmental perspective, there are enough water and related land resources to satisfy future resource demands

without resulting in the degradation of environmental quality. Such results can only be achieved, however, if future growth is guided away from environmentally sensitive areas to those locations which can adequately accommodate future developments. Also required is an enactment of means, whereby desirable growth is permitted. For example, most agricultural and forested land in the region is zoned "low density residential." Such zoning results in extensive developments which consume large acreage and also provide the vehicle for urban sprawl and increased service requirements. Therefore, if a regional goal is to preserve agricultural land, and if zoning ordinances are not modified to permit more intensive uses of land (e.g., cluster developments, planned unit developments, etc.), it is doubtful whether preservation goals can be attained.

Although the region supports a large population, significant portions of Plymouth and Bristol Counties can still be classified as predominantly rural with the important agricultural activities being dairying and cranberry culture. The area immediately south of the Boston metro area is suburban. The area to the north is best described as suburban with a small amount of farming mainly utilized for truck gardens and nursery stock enterprises. The environmental setting on Cape Cod and the Islands is a specialized situation geared to the enjoyment of the year-round residents and the thousands of summer visitors. Development on the Cape and Islands is concentrated in village centers, with additional scattered construction which appears to blend with the natural setting. Major agricultural enterprises include cranberry and vegetable production.

Agriculture, although not a predominant land use, ranks as an important factor in the economy, especially in Bristol and Plymouth Counties. Besides the economic value of farming in the region, another very important contribution comes from the aesthetically pleasing open space being created and maintained by farming. Pastures with grazing cattle, the neat rows of growing vegetables, and the expanses of colorful and interesting cranberry bogs all add to the visual quality of the area. In addition, the active management of these areas prevents them from reverting to forest vegetation, which is so common as to become monotonous at times.

There appears to be a growing realization on the part of the public as to the importance of maintaining farmland in production. One of the phases of this Massachusetts Water Resources Study has investigated the economic viability of farming in Massachusetts. Aside from the economic value of agriculture, the aesthetic values and the beneficial effects upon the environment are gaining greater recognition among the public and in state government. A bill has passed the legislature to authorize purchase, by communities, of development rights on farmland to encourage continued agriculture use to benefit both food supplies and the environment. An additional measure passed in 1977 provides $5,000,000 in state funds to acquire development rights. Several communities are investigating local programs to encourage and maintain agriculture. The Horticultural Land Assessment Act is another example of the state's efforts to retain an agricultural base for its many benefits.

D. Inland Water

The Coastal Region has over 51,900 acres of fresh open water, in addition to the 159,500-acres of inland wetlands. There are about 550 miles of major streams and tributaries.

Because of the flat topography, most of the streams and rivers are rather sluggish when compared to streams in the rest of Massachusetts. The flat gradient and tremendous wetland areas result in flood flows which are much lower than those experienced in other parts of the state. The slow movement of water through the stream system has also resulted in compounding water quality problems. Atmospheric reaeration and the resulting increase in dissolved oxygen is low because of low water velocities and associated low turbulence. Decaying organic material in wetland areas has also served, in some cases, to decrease the dissolved oxygen content and to give an undesirable color to the water.

The flat topography has also meant that most of the surface water reservoirs which have been built have relatively shallow ponds (less than 30 feet deep). In most cases, this is because the height of the dam was limited by the height of the natural abutments, and the need for extensive diking to avoid inundating too large an area.

Geology, too, has played an important role in limiting the depth of surface water bodies and determining the source of public water supplies. In the northern portion of the region, bedrock is relatively close to the ground surface and leakage through abutments and foundations of reservoirs can be controlled. However, in the southern portion, sand and gravel deposits are quite deep and leakage becomes a problem. On Cape Cod and the Islands, where sand deposits can be hundreds of feet deep, most ponds are natural depressions with a water level maintained at about the level of the surrounding water table. The exceptions on the Cape and Islands are ponds with one or two feet of flashboards used to raise the water level slightly above the groundwater level.

These geologic differences within the region have resulted in towns in the northern section relying on a combination of groundwater and some reservoirs of significant depth. In the southern section, groundwater becomes the predominant municipal water source with only 40 percent of the towns utilizing a combination of surface sources and groundwater, and only 11 percent using surface supplies only. On the Cape and Islands, municipal supply is entirely from groundwater, with the exception of Falmouth which uses a combination of groundwater and surface supply.

The topography and geology place some obvious restraints on future planning for water supply and recreation. There are some opportunities for new surface reservoirs, but they are limited.

4.7 PROJECTIONS

A. General Methodology

A major objective of the Massachusetts Water Resources Study (MWRS) is to project a number of important variables (land use, population, income, etc.) and thereby, identify areas that may experience potential problems. Once potential problems are recognized, alternative policies can then be developed which have as their objective the minimization of any such problems.

As the Southeastern New England (SENE) River Basin Study pointed out, the growth of a region and the quality and quantity of its water and related land resources are closely interrelated.[29/] New development creates demand for water (drinking, recreation, waste disposal) and also consumes land and may result in an encroachment upon ecologically and economically sensitive areas (e.g., flood plains, wetlands, and lands overlying aquifers). Projections are utilized to determine the extent and rate of development and whether increased demands on the resource base can be met with a set of projected resource supplies (water, land, transportation, etc.). Problems arise when critical resources of a minimum quality and quantity cannot satisfy such demand. For example, federal and state land use policies have placed a priority on the preservation of agricultural land (specifically, prime agricultural land). In the past, much of the development in the region has been at the expense of forest and agricultural land. Given the priorities on preserving such land, future growth and the demand for land give an indication of what is likely to occur, given recent trends. Such forward looking procedures also indicate the extent to which future growth must be guided.

B. Population Projections

The current and projected population figures were taken from material developed by the planning organizations located in the Coastal Region. These figures were utilized, rather than the OBERS figures, for the following reasons:

1. The geographic configuration of the region presents many difficulties in accurately allocating various OBERS SMSA population data to the region.

2. OBERS projections were developed, using 1972 data, whereas the planning commissions used more current information and trends.

3. National projections are disaggregated first to states, then regions, and finally to subregions. For each disaggregation, the probability of error increases correspondingly.

4. The Massachusetts Office of State Planning (OSP) has required that population projections for any particular planning region

be based on a consistent methodology which was developed by OSP. This methodology differs from that used in the 1972 OBERS projections.

Population projections are presented in Table 4.12.

TABLE 4.12 - POPULATION PROJECTIONS, 1975-1990, WITH PERCENTAGE CHANGES

	1975	1980	1985	1990
(Permanent) North	1,634,966	1,661,576	1,695,904	1,736,242
South	1,125,464	1,185,550	1,238,612	1,292,950
Cape Cod & Islands	141,110	155,300	175,700	180,000
Total Coastal (Permanent)	2,901,540	3,002,426	3,110,216	3,209,192
Seasonal Population	268,790	297,000	349,000	396,600
Permanent + Seasonal Total Coastal	3,170,330	3,299,426	3,459,216	3,605,792
- - - - - - - Regional Changes - - - - - - -				
Years	1975-1980	1975-1985	1975-1990	
Change (without Seasonal Population)	100,886	208,676	307,652	
% Change	3.47	7.19	10.60	
Change (with (Seasonal Population)	129,096	288,886	435,462	
% Change	4.06	9.11	13.74	

SOURCE: Massachusetts Office of State Planning and the various planning commissions representing the towns located in the Coastal Region.

C. Land Use Projections

A number of methodologies were utilized to project land use categories to 1990. The categories are:

1. Agricultural Land
   a. Total cropland
      (1) Harvested cropland
      (2) Pasture/grazing cropland
      (3) All other cropland
   b. Woodland
   c. All other farmland
   d. Total land in farms
2. Urban Land
   a. Industrial land
   b. Commercial land
   c. Institutional land
   d. Residential land
3. Open Water Areas
4. Wetlands
5. Forestland
6. All Other Land

Agricultural land was projected by using historical agricultural census land use data which was weighted heavier in the latter years of the data (1964, 1969, 1974) to reflect more recent trends. Since agricultural census data is delineated on a county basis, it was necessary to allocate data from those counties which are located in more than one study region. The allocation was accomplished by using MacConnell's land use data[30/] to determine the amount of agricultural land by town in each region. These proportions were formulated and used to adjust the county census data to reflect that data which is derived from the Coastal Region. Once the adjusted census data was enumerated for each subregion, a Markov probability program was used to project the 1990 shares by agricultural land use category. The OBERS total agricultural land projection was used to compute the 1990 land and farms acreage. From the Markov probability program, a set of proportions for each agricultural land use category was determined for 1990. These proportions were then multiplied times the OBERS total land in farms figure to derive 1990 projected acreage by agricultural land use category.

The projected change from 1975 to 1990 suggests that a 4.2-percent decline will occur on total land in farms (a decline of 6,574 acres). Looking at the subcategories of agricultural land, the projections suggest that pasture/grazing cropland and all other cropland will increase (the former by 6.5 percent - 650 acres, and the latter by 21.3 percent - 677 acres). The sharpest decline occurs in the category "all other land in farms" from 38,344 acres in 1975 to 33,880 acres in 1990, representing a decline of 4,464 acres, or 11.6 percent. Harvested cropland is projected to decline by 7.7 percent, or from 42,763 acres in 1975 to 39,466 acres in 1990.

Urban land was projected by using historical land use data developed by William P. MacConnell, University of Massachusetts. Utilizing this data, plus residential population projections for 1990 as supplied by the planning agencies in the region, a log-linear regression model was used to fit urban land shares to population density by town. A number of different regression models were run, but the population density model together with historical urban land acreage was found to be the most accurate.

Base year data for 1950 and 1970 was used to estimate the regression coefficients for the entire Coastal Region. Similar regressions were also calibrated by subregions to reveal regional differences. Weighted aggregations of these coefficients by region and subregion for 1950 and 1970 were used in the final regression model to predict or project urban land use by subregion for 1990. With the limited data (1950, 1970), this model is very efficient, relative to larger land use models, for it makes use of minimal data requirements.

Population projections were not complete for the Cape Cod and Islands subregions. For that reason, the total projected urban land may be somewhat understated. The projected urban land area for the entire Coastal Region is expected to amount to 393,567 acres by 1990. With respect to the subregions, the following projections are noted: northeast - 143,498; southeast - 190,437; and Cape Cod and Islands - 59,732. The percent changes between 1970 and 1990 amount to 10.65 percent in the northeast, 17.86 percent in the southeast, and 23.93 percent in Cape Cod and Islands. Translating these percentages to the Coastal Region area results in a 15.97-percent increase of 54,191 acres in urban land by 1990. Thus, where in 1970, urban land was approximately 20.2 percent of the total coastal area, by 1990 it is expected to amount to 23.4 percent. The 1990 projections for open water area is expected to remain approximately the same as the 1970 figure of 95,847 acres. This figure may understate the total expected open water, because there is one Public Law-566 Water Impoundment Project presently being constructed in the region. However, the additional acreage is minimal.

Wetland acreage was projected, using historical trend analysis in conjunction with the impact of wetland preservation enactments. Almost all of the wetland acreage data were developed by the Soil Conservation Service. From this data, the 1976 wetland acreage in the Coastal Region was determined. There were three major subcategories in wetland land use: open, wooded, and salt marsh. From analyzing historical trends and adjusting such trends to reflect wetland preservation regulations, it was determined that the average annual decrease in wetland acreage through 1990 from open and wooded wetlands (not salt marsh) would be .4 percent. MacConnell's 1970 wetland acreage figure (83,200 acres) is an aggregation of both salt marsh and open type wetland. In order to accurately reflect possible or potential forestland decreases, it was necessary to separate out that forestland which was in fact wetland. An assumption was made that the salt marsh acreage and the open type wetland acreage were of the same proportion in 1970 as they were in 1976 (i.e., the proportion reflected in the 1976 Soil Conservation Service data). It was also assumed that wooded swamp land was also in

similar proportions to the total open and salt marsh wetlands. It was necessary to derive a total wetland figure for 1970, so that adjusted historical rates of decline would equal the 1976 SCS data of 200,231 acres. The 1970 wooded wetland was computed to be 120,938 acres and that, when summed to the 83,200-acres of open and salt marsh land, equals 204,138 total acres of wetland for 1970.

MacConnell's 1970 forestland acreage was adjusted downward by subtracting the wooded swamp acreage determined above, and woodland on farms. These two categories were subtracted from MacConnell's data, because trend analysis reflected differing rates of decline for each of the wooded wetland and the woodland on farms. Also, since woodland on farms is included in the agricultural land category, including it in the forestland category would result in double counting. Once the adjustments were accomplished, the 1970 forestland acreage was adjusted from 908,000 acres to 722,370 acres. Trend analysis was then used to project forestland to 1990.

The final land use category--"other" land use was projected as the residual from the above land use categories.

Table 4.13 summarizes the 1990 land use projections.

TABLE 4.13 - 1990 LAND USE PROJECTIONS AND CHANGES, 1975-1990

ITEM	1990 Acreage	1975 Acreage	Change	Percent Change
Total Agricultural Land[1/]	149,777	156,351	- 6,574	- 4.2
Total Cropland	53,919	55,889	- 1,970	- 3.5
Harvested cropland	39,466	42,763	- 3,297	- 7.7
Pasture/grazing cropland	10,604	9,954	+ 650	+ 6.5
All other cropland	3,849	3,172	+ 677	+21.3
Woodland on farms	61,978	62,117	- 139	- 0.2
All other farmland	33,880	38,344	- 4,464	-11.6
Urban Land	393,567	339,376	+54,191	+16.0
Water	95,847	95,847	--	--
Wetlands	191,301	204,138	-12,837	-6.2
Forestland[2/]	689,858	722,370	-32,512	- 4.5
All Other Land	159,450	139,875	+19,575	+14.0

1/ Agricultural acreage for 1974; other from 1971.
2/ Excludes wooded wetlands and woodland on farms.

D. Economic Projections

As Section 4.1 discussed, the Coastal Region has progressed through three economic periods. Projections to 1990 suggest a continuing of

the latest trend--increased employment and earnings in the service-related industries relative to the manufacturing sector. The economic projections, summarized in Table 4.14, were formulated using OBERS Series E projections,[31/] gathered for the Boston and New Bedford-Fall River SMSAs, and then combined to illustrate economic trends in the region. There is a slight shortcoming in extrapolating the data to the whole Coastal Region, in that the two regions do not geographically overlap. However, in this study, the direction and velocity of identifiable trends are more relevant considerations than the absolute numbers. In this light, the fact that there is not an exact geographical parallelism, does not detract from the validity of the analysis.

From Table 4.2, there was an increase in manufacturing earnings of $1.4 billion between 1950 and 1970, or nearly 68 percent. At the same time, there was an increase in service-related industries (finance, insurance, real estate, services, government) of $3.5 billion during the same period resulting in an increase of 185 percent. From Table 4.14, the respective increases for the 20-year period between 1970 and 1990 are:

1. Manufacturing earnings = $2.0 billion, or 57 percent;
2. service-related earnings = $8.3 billion, or 153 percent.

Total earnings are expected to increase by nearly $14 billion, or 108 percent gain.

In reference to the objectives of this study, the question must be asked how will or how might the expected economic and social trends affect the region's water and related land resources? This question can be answered by determining what new demands will be placed on these resources. The SENE study concluded optimistically:

> Demographic and land use studies showed rather conclusively that for the foreseeable future the overall growth in the SENE Region is clearly not limited by the region's water and related land resources. There is enough space (....) to accommodate all growth to 2020 even at the spectacular high rate of land consumption of the last decade. Growth can be accomodated, but it needs guidance.[32/]

In other words, with proper land use guidance, the overall growth, both economic and social, should not adversely impact upon the region's water and related resources.

The economic projections are based upon the assumptions set forth in the OBERS Report. If these assumptions are shown to be invalid for a particular region, the projections as presented would need to be adjusted accordingly.

E. Wood Products Projections

The tabulation derived from OBERS presents estimates on the projected potential of wood product production in the Coastal Region through 1990.

TABLE 4.14 - POPULATION, EMPLOYMENT, PERSONAL INCOME, AND EARNINGS BY INDUSTRY, HISTORICAL AND PROJECTED, SELECTED YEARS, 1962-1990

ITEM	Historical		Projected	
	1962	1970	1980	1990
Population, midyear	3,838,982	4,160,187	4,577,800	5,046,700
Per capita income (1967 dollars)	2,952	3,958	5,446	6,957
Total employment	1,500,971[1/]	1,723,537	2,097,900	2,318,400
Employment/population ratio	.39	.41	.46	.46
	----------In Thousands of 1967 Dollars----------			
Total personal income	11,331,659	16,464,485	24,931,500	35,109,800
Total earnings	9,203,213	12,967,402	19,307,600	26,963,600
Agriculture, forestry and fisheries[4/]	70,837[2/]	62,260[2/]	87,400	97,200
Agriculture			62,900	66,900
Mining[4/]	3,469[3/]	4,044[3/]	24,400	30,200
Nonmetallic, except fuel			7,500	8,900
Contract construction	509,735	824,967	1,216,500	1,636,300
Manufacturing[4/]	2,961,606	3,521,467	4,504,200	5,534,500
Food and kindred products			266,700	312,200
Textile mill products			129,300	116,100
Apparel and other fabric products			226,500	236,000
Lumber products and furniture			60,100	68,800
Paper and allied products			157,700	188,800
Printing and publishing			344,600	451,600
Chemicals and allied products			164,100	227,700
Petroleum refining			8,700	9,600
Primary metals			74,000	77,700
Fabricated metals and ordnance			441,500	598,300
Machinery (excl. elec.)			560,500	683,600
Electrical machinery and supplies			850,800	1,039,200
Motor vehicles and equipment			64,900	80,200
Transportation equipment (excl. motor vehicles)			198,600	228,400
Other manufacturing			953,800	1,214,700
Transportation, Communications, and public utilities[4/]	605,234	845,583	1,285,200	1,807,500
Railroad transportation			46,000	46,200
Trucking and warehousing			319,300	452,800
Other transportation and services			302,000	405,700
Communications			430,400	652,000
Utilities (electricity, gas, sanitary)			187,000	250,500
Wholesale and retail trade	1,681,912	2,284,519	3,210,800	4,183,400
Finance, insurance and real estate	607,683	878,114	1,374,600	1,949,200
Services[4/]	1,496,407	2,654,897	4,808,700	7,625,800
Lodging places and personal services			222,600	264,200
Business and repair services			990,900	1,581,100
Amusement and recreational services			92,200	123,700
Private households			72,100	76,000
Professional services			3,430,500	5,580,500
Government	1,257,468	1,873,116	2,812,100	4,119,900
Federal government	365,640	484,528	650,400	901,100
State and local government	730,922	1,195,718	1,968,400	2,973,000
Armed forces	160,906	192,875	192,900	245,700

1/ Employment is for 1960.
2/ Represents 80.0 to 99.9 percent of the true value.
3/ Represents 60.0 to 79.9 percent of the true value.
4/ Historical data for subcategories were deleted from the OBERS report, Volume 5.
SOURCE: 1972 OBERS Projections, Economic Activity in the U.S., Volume 5, Standard Metropolitan Statistical Areas, Series E., pp. 40 and 79.

The projected potential, although used for the analysis in this report is somewhat artificial, for it is based on area of forestland and productivity and does not account for the availability of forestland. It is used only as a benchmark in the analysis.

TABLE 4.15 - POTENTIAL WOOD PRODUCT PROJECTION

Year	Millions of Cubic Feet
1980	8.2
1990	9.2

F. Outdoor Recreation Projections

Projected demand for water-based and water-related outdoor recreation activities in 1990 have been obtained from adjusted demand figures from the 1976 Statewide Comprehensive Outdoor Recreation Plan (SCORP) and presented in Table 4.16.

TABLE 4.16 - PROJECTED 1990 RECREATION DEMAND

Activity	Demand (1,000 Activity Days)
Swimming	45,298
Camping	3,269
Picnicking	15,573
Canoeing-Sailing	6,468
Hiking	10,793

NOTES

1/ OBERS is an acronym for the Office of Business Economics (OBE--presently named Bureau of Economic Analyses, U.S. Department of Commerce) and the Economic Research Service (ERS--presently named Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture).

2/ Meir, Peter, Stachostic Population Dynamic for Regional Water Supply and Waste Management Decision Making, Technical Report No. EVE 25-70-5, University of Massachusetts, Amherst, Massachusetts, August, 1970.

3/ 1972 OBERS Projections, Regional Economic Activity in the U.S., Series E, U.S. Water Resources Council, Washington, D.C., 1974.

4/ Report of the Southeastern New England Study, Regional Report, New England River Basins Commission, Boston, Massachusetts, 1977, pp. 2-10.

5/ 1974 Census of Agriculture, Volume I, U.S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census, Washington, D.C., April 1977.

6/ Cash receipts are for all farms with sales greater than or equal to $2,500.

7/ Cash receipts for all farms.

8/ Glass, Ronald A. Water Use in Cranberry Production, Southeastern Massachusetts, Economic Research Service, U.S. Department of Agriculture, Upper Darby, Pennsylvania, 1975.

9/ This figure was computed by taking the 1973 estimated total water requirements for cranberry production by planning area (Glass, p. 40), and dividing this figure by acres in cranberry bogs (Glass, p. 13) to arrive at an average acre water by planning area. These per acre estimates for each of the five planning areas were summed and then divided by 5 to determine an estimated average water requirement per acre for the region as a whole.

10/ Barker, Brian and John W. Green, A Procedure for Determining Town Employment by Place of Work, Economic Research Service, U.S. Department of Agriculture, Upper Darby, Pennsylvania, 1974.

11/ It should be noted that probably a large proportion of these farms are either part-time enterprises or enterprises which seek to accrue tax benefits. With the 1976 National Tax Act, however, tax benefits over the near future will not be as large as they once were. Thus, one could expect that such enterprises would either be sold or simply not defined as farms in future censuses.

12/ A Policy for Food and Agriculture in Massachusetts, Executive Office of Environmental Affairs, Department of Food and Agriculture, Boston, Massachusetts, 1976, p. 6.

13/ Ibid.

14/ Christensen, Robert L., John H. Foster, and Donald R. Marion, Self Sufficiency for Food in Massachusetts (Part II) Cooperative Extension Service, University of Massachusetts, U.S. Department of Agriculture and County Extension Services Cooperating, Amherst, Massachusetts, 1976.

15/ Ibid.

16/ Ibid.

17/ MacConnell, William P. et al., Remote Sensing 20 Years of Change in Massachusetts, University of Massachusetts, Amherst, Massachusetts, July 1975.

18/ Bones, James T., 1973, Primary Wood Product Industries of Southern New England, U.S. Department of Agriculture, Forest Service, Resource Bulletin NE-30. Updated to 1976 through interviews with Massachusetts Service Foresters.

19/ NARWRSCC, 1972, North Atlantic Regional Water Resources Study, Appendix C, Climate, Meteorology and Hydrology.

20/ From interviews with Massachusetts Service Foresters.

21/ Shaw, Samuel and David Gansner, A paper on "Incentives to Enhance Timber and Wildlife on Private Forest Lands," 1976.

22/ Massachusetts Division of Conservation Services, 1973, Massachusetts Outdoor Recreation Plan and interviews with Massachusetts State Foresters.

23/ Directory of Commercial Sawmill Operators and Loggers in Massachusetts, 1975, Cooperative Extension Service, University of Massachusetts, Amherst, Massachusetts.

24/ Massachusetts Industrial Directory 1974-75, Massachusetts Department of Commerce and Development, Boston, Massachusetts.

25/ Ibid.

26/ Department of Hotel, Restaurant and Travel Administration, University of Massachusetts at Amherst, The Economic Impact of Tourism on the Commonwealth of Massachusetts, prepared for the Department of Commerce and Development, State of Massachusetts (Amherst, Massachusetts, December 1974), p. 1.

27/ Ibid.

28/ Based on telephone conversation June 1, 1977 with Norman G. Cournoyer, Department of Restaurant and Travel Administration, University of Massachusetts, Amherst, Massachusetts.

29/ Report of the Southeastern New England Study, Regional Report, New England River Basins Commission, Boston, 1975, p. 3-1.

30/ MacConnell, W. P. et al., op. cit.

31/ 1972 OBERS Projections, Economic Activity in the U.S., Vol. 5, Standard Metropolitan Statistical Areas, Series E, pp. 40 and 79.

32/ Report of the Southeastern New England Study, New England River Basins Commission, December 1975.



Provincetown, Massachusetts: Nature's artistry is expressed along the shore of Cape Cod where restless Atlantic winds etch the sand in wavy patterns with the rhythm of the seas.

5

RESOURCE BASE & EXISTING PROGRAMS

5.1 GENERAL

The Coastal Region includes approximately 2,600 square miles and is composed of many small independent watersheds which flow directly into the Atlantic Ocean. Unlike the Connecticut River Basin, the Coastal Region is not united by a single great river. The Taunton River Watershed forms the largest area drained by a single river in the region.

Major streams within the Coastal Region are shown below:

Subregion	Study Area	Major Streams
Northeast	Parker	Parker River
	Ipswich	Ipswich River
	North Shore	Saugus River
		Mystic River
	Neponset	Neponset River
Southeast	South Shore	North River
	Taunton	Taunton River
	Buzzards Bay	Agawam River
		Weweantic River
		Westport River
	Narragansett Bay	Ten Mile River
		Palmer River
Cape Cod	Cape Cod	Bass River
		Herring River
	Islands	-

All of these streams listed drain directly into tidewater. The Charles River is not included here, as the MWRS work on the Charles River[1/] was done in coordination with the Corps of Engineers' Implementation Study[2/] completed in 1972.

The Coastal Region consists of 127 cities and towns: 47 in the northeast, 57 in the southeast, and the 23 towns of Cape Cod and the Islands. Plymouth, Bristol, Barnstable, Dukes, Nantucket, and Suffolk Counties are entirely within the region. Portions of Middlesex, Essex, and Norfolk Counties are also within the region.

Region boundaries were originally selected, based on the hydrologic watershed boundaries as being natural dividing lines, for a study of water and related land resources. Because of the importance of municipal governments in planning and implementing measures in Massachusetts, it was decided to

adjust the hydrologic region boundaries so that all of a town's area could be assigned to one region. The towns which were included in the Coastal Region are indicated on Figure 5.1.

Although the region is dominated by the urbanized Boston metropolitan area and by smaller urban centers of Brockton, Fall River, Lawrence, Haverhill, and New Bedford, there is still rural and undeveloped land. While population densities range as high as 21,600 persons per square mile in Somerville, next to Boston, there are 13 towns with population densities of less than 100 persons per square mile. The lowest density in the region is in the island town of Gosnold, with 6 persons per square mile.

A. Soils

The soils of the Coastal Region have formed in materials influenced by glaciation. The region's many upland hills and ridges are mantled with two or three feet of friable, loamy or sandy material underlain by firm or friable, loamy or sandy, heterogenous glacial till. Stones and boulders are normal surface features in wooded areas. Bedrock outcrops are common, especially on steeper slopes.

Intermingled with the uplands, in valleys and lower positions and on relatively broad plains, are soils formed in materials influenced by glacial meltwater. Slopes in these areas range from nearly level to moderately steep. The soils are quite varied, but all have substrata of sand or sand and gravel. The surface soil and subsoil portions may be silty, loamy or sandy and contain varying amounts of gravel.

Minor areas in the extreme northern and eastern parts of the region and the extremities of the Cape and Islands include beaches, tidal marshes, sand dunes and soils formed in glacial lakebeds.

The general soil map for the Coastal Region is on Figure 5.2. Fourteen broad associations are recognized. For the purposes of convenience and discussion, the associations are grouped into five larger sections based on the type of material in which each formed.

Soils formed dominantly in dense firm glacial till:

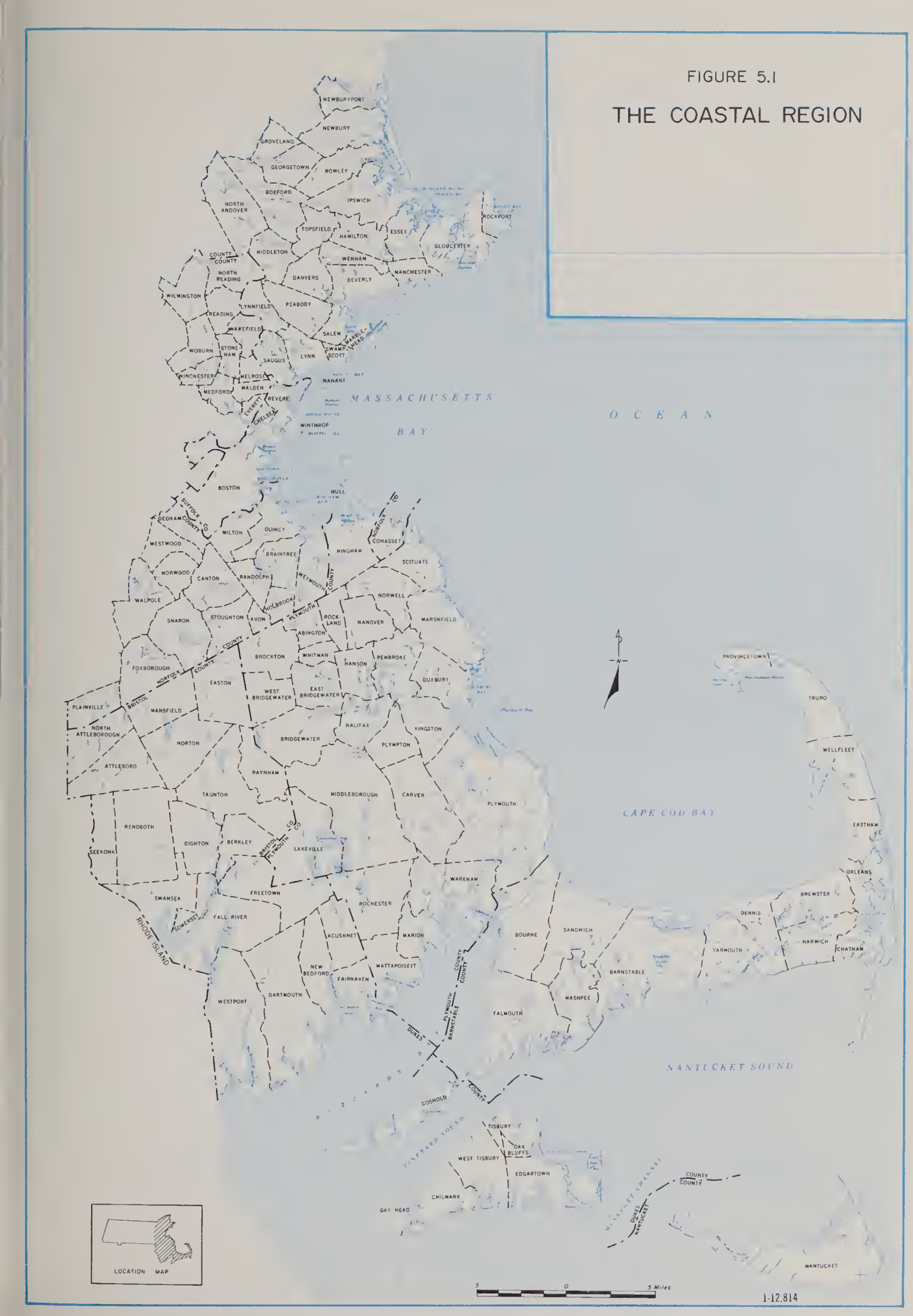
1. Paxton-Hollis-Canton association

These fine sandy loam soils are on gently sloping to steep hills and ridges throughout the uplands of the northern part of the region. Stones and boulders are scattered over the surfaces of many wooded areas. Bedrock outcrops are common in some areas, particularly on the steeper slopes. These soils are well to excessively drained and are free of problems associated with soil wetness.

This association has three dominant soils. The Paxton soils have loamy, slowly permeable substrata and make up to 50 percent of the association; the shallow to bedrock Hollis soils constitute

FIGURE 5.1

THE COASTAL REGION



about 15 percent; an
sandy, permeable sub
percent of the assoc

2. Scituate-Essex-Ridge

These soils are on n
and upland depressio

Scattered stones and
wooded areas. The r
substrata. A season
of months in the Rid

Three major soils a
moderately well dra
mantle over sandy su
of the association.
sand subsoils and s
ation consists of Es
soils make up about
of minor soils cons

3. Paxton-Whitman-Woodb

These soils are on r
ridges and upland d
region. Stones and
wooded areas. Compa
to the major soils
dominant in both th
have a water table

The three named soi
well drained Paxton
association; the we
Woodbridge, a moder
Numerous other soil

Soils formed dominantly

4. Canton-Plymouth-Car

These soils are on
forms in the southe
few surface stones
or excessively drai

Plymouth and Carver
and substrata. Car
sand substrata. Al

25 percent Plymouth, and 20 percent Carver soil. The remaining 25 percent consists of numerous minor soils.

5. Gloucester-Muck-Hinckley association

This association contains soils formed in friable glacial till, water sorted glacial outwash and pockets or swales of organic deposits. These contrasting materials are intermingled in an area in the southern part of the region. The soils in this association are on gently sloping to moderately steep uplands, nearly level flats and nearly level to undulating terraces. Wooded areas of Gloucester soils often have a few surface stones and boulders. Gloucester and Hinckley soils on gentle slopes are suited for agriculture, but they tend to be drouthy. Muck soils are too wet for most uses.

Gloucester soils make up about 50 percent, Muck about 15 percent, and Hinckley about 15 percent of this association. 20 percent consists of a number of minor soils.

6. Canton-Paxton-Merrimac association

This association consists of soils formed in glacial till as well as soils formed in water sorted glacial outwash. The contrasting materials are closely intermingled in a small area in the northern part of the region. The soils are on nearly level to undulating terraces and gently sloping to moderately steep upland ridges. They have fine sandy loam surfaces. Wooded areas of Canton and Paxton soils often have surface stones and bedrock outcrops are in some areas. The lower slopes of all these soils are suited for agriculture. They are well drained and soil wetness is not a problem.

Canton and Merrimac soils have permeable, sandy substrata. Paxton soils have compact, slowly permeable substrata. This association is composed of about 50 percent Canton soils, 20 percent Paxton soils, and 20 percent Merrimac soils. Other minor soils make up the remaining 10 percent.

7. Plymouth-Chilmark-Nantucket association

The soils in this association formed in glacial till. They are on nearly level to steep moraine land forms, primarily on the islands of Martha's Vineyard and Nantucket. These soils are well to excessively drained, and soil wetness is generally not a problem. The nearly level to sloping areas of Chilmark and Nantucket soils are suited for agriculture and many other uses.

The Plymouth soils have permeable sandy subsoils and substrata. They make up about 50 percent of the association. Chilmark and Nantucket soils have loamy subsoils and firm loamy substrata.

About 15 percent of the association is Chilmark soils and 15 percent Nantucket. Other minor soils make up the remaining 20 percent.

Soils formed dominantly in water sorted glacial outwash:

8. Hinckley-Windsor-Muck association

The soils in this association formed in glacial outwash and in pockets of organic materials. They are generally in the valleys on nearly level to rolling terraces, kames, deltas and eskers. Numerous areas of this association are suited to agriculture. Many soils in this group are free of water table problems and in fact are limited by drouthiness. Muck soils, however, are too wet for most uses.

Three major soils dominate this association. The permeable Hinckley soils have sandy or sand or gravelly substrata. About 40 percent of the association are Hinckley soils. Windsor soils have very permeable, sandy substrata and make up about 30 percent of the unit. The wet organic Muck soils make up about 10 percent of the association. A number of other minor soils constitute the remaining 20 percent.

9. Hinckley-Canton-Muck association

These soils formed in glacial outwash, sandy glacial till and in pockets of organic deposits. These contrasting materials are closely intermingled in an area in the west central part of the region. The soils are on nearly level to rolling terraces and broad, gently sloping to moderately steep, upland ridges. Soil wetness is not a problem in the excessively drained Hinckley or the well drained Canton soils. The lower slopes of these soils are suited for agriculture, but there is a drouthiness problem. The Muck soils are far too wet for most uses.

Hinckley soils have sandy or sandy and gravelly subsoils and substrata. Canton soils have loamy subsoils and sandy substrata. The permeability of both these soils is rapid. The organic material of the Muck soils are waterlogged most of the year. About 40 percent of the association is Hinckley, about 30 percent is Canton, and 10 percent is Muck. A number of minor soils make up the remaining 20 percent.

10. Carver-Muck-Hinckley association

The soils in this association formed in water sorted materials, primarily glacial outwash, and in pockets of organic materials. They usually are on broad, nearly level to undulating, outwash plains in the southern part of the region. Both the Carver and Hinckley soils have a drouthiness problem when cultivated, but are suited for other uses. Muck soils are too wet for most uses.

Three major soils are dominant in this association. Both Carver and Hinckley soils have permeable sandy or sandy and gravelly subsoils and substrata. Muck soils consist of waterlogged organic materials. About 40 percent of the association is Carver, about 15 percent is Muck, and about 15 percent is Hinckley. The remaining 30 percent consists of numerous minor soils.

11. Dukes-Carver-Tidal Marsh association

The soils in this association formed in water sorted and wind influenced sands and in organic deposits subject to tidal flooding. They are on nearly level to rolling land forms on the outer reaches of Cape Cod. The sandy Dukes and Carver soils retain water very poorly and are very drouthy. The wet tidal marsh areas are flooded twice daily by the ocean tide.

About 35 percent of the association is Dukes soils, about 30 percent Carver soils, and about 15 percent is tidal marsh. Numerous other soils make up the remaining 20 percent.

12. Evesboro-Riverhead-Katama association

These soils formed primarily in water sorted glacial outwash materials. They are on broad, nearly level to undulating, outwash plains on the southern part of the islands of Martha's Vineyard and Nantucket. The three major soils have sandy substrata, but Riverhead and Katama have sandy loam subsoils. All these soils have low capacity to retain moisture and are drouthy.

About 50 percent of the association is Evesboro, about 20 percent Riverhead, and 20 percent Katama. About 10 percent of the association consist of numerous other minor soils.

Miscellaneous areas of wind deposited sand, ocean washed beaches, and tidal flooded marshes:

13. Dune Land-Tidal Marsh-Beaches association

This association is composed of areas of wind deposited sands and tidal flooded beaches and marshes of organic material. Fifteen small areas of this asscoiation are scattered along the coastlines. The sandy dune land is primarily stabilized by beach grass and a few other plants. Beaches are chiefly sandy and barren of vegetation. The tidal marshes are well vegetated with salt grass, but are wet and are flooded twice a day by the tidal flow.

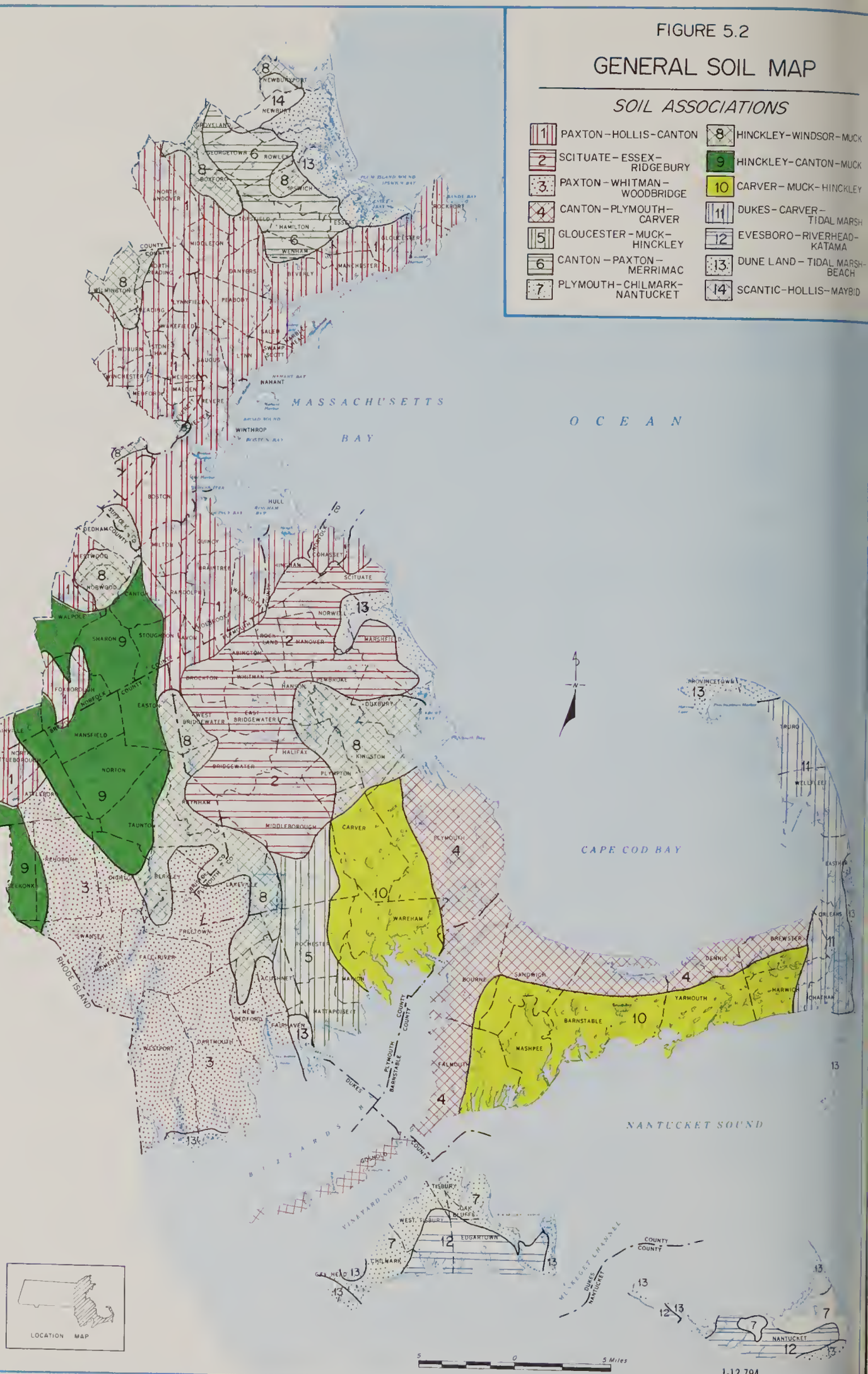
About 50 percent of the association is dune land, about 40 percent tidal marsh, and 10 percent beaches.

FIGURE 5.2

GENERAL SOIL MAP

SOIL ASSOCIATIONS

1 PAXTON–HOLLIS–CANTON	8 HINCKLEY–WINDSOR–MUCK
2 SCITUATE–ESSEX–RIDGEBURY	9 HINCKLEY–CANTON–MUCK
3 PAXTON–WHITMAN–WOODBRIDGE	10 CARVER–MUCK–HINCKLEY
4 CANTON–PLYMOUTH–CARVER	11 DUKES–CARVER–TIDAL MARSH
5 GLOUCESTER–MUCK–HINCKLEY	12 EVESBORO–RIVERHEAD–KATAMA
6 CANTON–PAXTON–MERRIMAC	13 DUNE LAND–TIDAL MARSH–BEACH
7 PLYMOUTH–CHILMARK–NANTUCKET	14 SCANTIC–HOLLIS–MAYBID



Soils formed in glacial lakebeds:

14. Scantic-Hollis-Maybid association

The soils in this association formed in clayey lake or marine deposits. The soils are dominantly on nearly level flats in the extreme northern part of the region. They are primarily poorly or very poorly drained, slowly permeable, clayey soils. The association is a minor part of the region. Bedrock outcrops are common in some areas. Wetness and restricted permeability are problems for most uses of these soils.

The Scantic, Hollis and Maybid soils are dominant in this association. Hollis soils are shallow to bedrock, but the other soils are deep to rock. Scantic soils make up about 40 percent of the association, Hollis soils about 20 percent, and Maybid soils 20 percent. Other minor soils comprise about 20 percent of the association.

B. Geology[3/]

Most of the region lies within the Coastal Lowland section of the New England Physiographic Province, with Cape Cod and the offshore Islands within the Coastal Plain Province. The region has a gently rolling topography and a drainage pattern consisting of a series of wetland areas interconnected by a system of streams and rivers. The topography is the result of changes induced by the glacial movements during the last ice age, over 10,000 years ago. The coastline has many interesting geologic features, such as sandy beaches and offshore bars, salt marshes, estuaries, stationary and "walking" sand dunes, and rockbound sections of coast.

Bedrock in the region includes types of igneous, metamorphic and sedimentary rock. In most areas, the bedrock is at least 10 feet from the surface, but rock outcrops are common in the northern half of the area. In the southern part of the region, especially on Cape Cod and the Islands, sand and clay deposits may overlay bedrock by hundreds of feet. Sedimentary rocks (conglomerates, shales, sandstone) are commonly found in the southern part of the region with the igneous and metamorphic rocks located to the north. Martha's Vineyard has the unique presence of Cretaceous coastal plain deposits outcropping at Gay Head and present throughout the western part of the island in the subsurface.

Most of the unconsolidated geologic material owes its origin to the ice age glacier, which eroded large quantities of rock and redeposited the material as dense glacial till, a mixture of silt, sand, gravel, cobbles, and boulders. As the glacier melted, large quantities of materials were loosely deposited as moraines, the most prominent being Cape Cod.

Water from the melting glacier formed streams which transported and deposited sediment as glacial outwash. The sediment was deposited in broad, flat outwash plains. Elsewhere, outwash partially filled deep valleys in

the bedrock surface. Some of the waterborne sediment was deposited against remnant blocks of glacial ice. Glacial outwash and ice contact deposits are composed of sand and gravel.

Glacial meltwater was trapped in depressions or in stream valleys which were dammed by ice. Thin layers of clay, silt, and fine sand collected on the bottom of these lakes. Streams entering the lakes created deltas of sand. After the glacier had receded, the dams were breached, lakes drained, and the topography assumed its present appearance, with many wetland pockets connected by slow-moving, low-gradient streams.

C. Vegetative Cover[4/]

Approximately 80 percent of the region is in nonurban uses. Forestland is by far the most dominant, with 908,000 acres (54 percent), with agriculture, wetlands, water and other land contributing 25 percent.

With respect to forestland, hardwood forestland outnumbers softwood by approximately three to one, but the tree volume is about equally divided between softwood and hardwood species. White pine is the predominant softwood, with lesser volumes of pitch pine and hemlock. Soft maple is the predominant hardwood, with lesser volumes of white and red oaks. Several unique vegetative-landform types occur on the Islands. The heathlands and moors of the western portion of Martha's Vineyard are interesting examples.

D. Climate

The average annual temperature is approximately 50 degrees Fahrenheit (^{o}F) with an average in January of about 30^{o}F, and an average in July of about 71^{o}F. Inland, the summers are hot and humid, but sea breezes cool the areas near the coast. The length of the growing season (frost free period above 32^{o}F threshold) averages about 170 days. Growing season varies from less than 150 days inland to nearly 200 days in the immediate coastal areas.

Mean annual precipitation is about 44 inches. Snowfall depths vary widely from year to year, depending greatly on the track taken by winter storms. Snowfall depths can easily range from 30 to 70 inches per year. Average snowfall in the Boston area is about 50 inches, with about 30 inches being the average for the southern part of the region including Cape Cod and the Islands. The average annual runoff is about 22 inches, over 50 percent of the average annual precipitation.

See Figures 5.3, 5.4, and 5.5 for Climatological Data.

E. Storms and Droughts

Major storms and subsequent floods have occurred in nearly every month of the year. Large storms which affect the region are usually fall hurricanes, summer thunderstorms, or winter "northeasters". The most significant storms were the hurricanes of September 1938, September 1944,

FIGURE 5.3

AVERAGE ANNUAL PRECIPITATION

(INCHES)



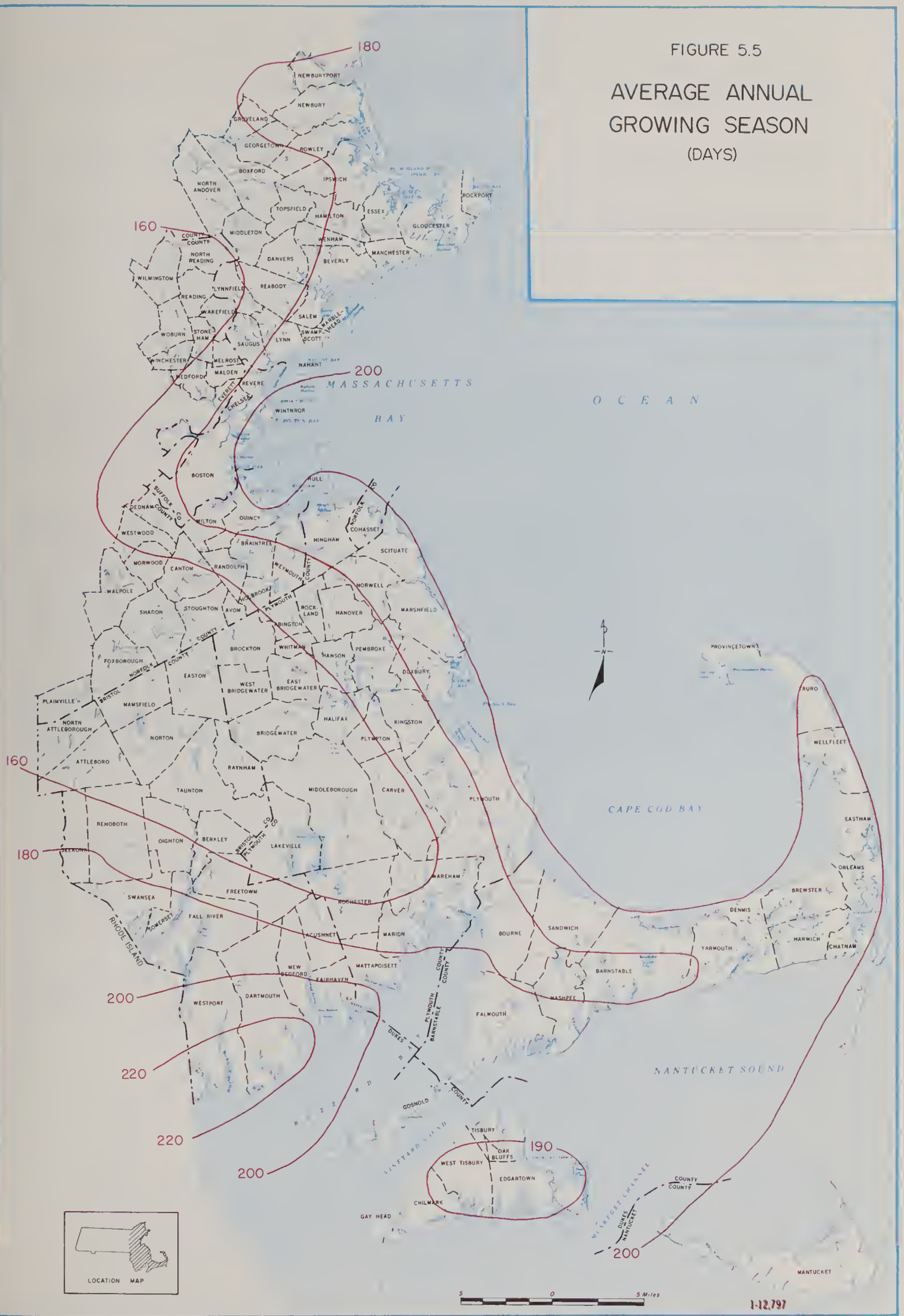


This Great Horned Owl was photographed in Walpole, Norfolk County, Massachusetts.


FIGURE 5.4
AVERAGE ANNUAL SNOWFALL
(INCHES)
60
50
40
30
MASSACHUSETTS BAY
OCEAN
CAPE COD BAY
NANTUCKET SOUND
RHODE ISLAND
NEWBURYPORT
NEWBURY
GROVELAND
GEORGETOWN
ROWLEY
BOXFORD
IPSWICH
ROCKPORT
NORTH ANDOVER
TOPSFIELD
HAMILTON
ESSEX
GLOUCESTER
MIDDLETON
WENHAM
MANCHESTER
NORTH READING
DANVERS
BEVERLY
WILMINGTON
PEABODY
LYNNFIELD
READING
WAKEFIELD
SALEM
MARBLEHEAD
SWAMPSCOTT
WOBURN
STONEHAM
SAUGUS
LYNN
WINCHESTER
MELROSE
NAHANT
MEDFORD
MALDEN
REVERE
EVERETT
CHELSEA
WINTHROP
BOSTON
HULL
DEDHAM
MILTON
QUINCY
CONCORD
WESTWOOD
BRAINTREE
HINGHAM
SCITUATE
NORWOOD
CANTON
RANDOLPH
NORWELL
WALPOLE
HOLBROOK
ROCKLAND
HANOVER
MARSHFIELD
SHARON
STOUGHTON
AVON
ABINGTON
BROCKTON
WHITMAN
HANSON
PEMBROKE
FOXBOROUGH
EASTON
DUXBURY
WEST BRIDGEWATER
EAST BRIDGEWATER
PLAINVILLE
MANSFIELD
NORTH ATTLEBOROUGH
HALIFAX
KINGSTON
NORTON
BRIDGEWATER
PLYMPTON
ATTLEBORO
RAYNHAM
TAUNTON
MIDDLEBOROUGH
CARVER
PLYMOUTH
REHOBOTH
DIGHTON
BERKLEY
SEEKONK
LAKEVILLE
WAREHAM
SWANSEA
FREETOWN
ROCHESTER
FALL RIVER
ACUSHNET
MARION
BOURNE
SANDWICH
NEW BEDFORD
MATTAPOISETT
FAIRHAVEN
BARNSTABLE
YARMOUTH
DENNIS
HARWICH
CHATHAM
BREWSTER
ORLEANS
EASTHAM
WELLFLEET
TRURO
PROVINCETOWN
WESTPORT
DARTMOUTH
MASHPEE
FALMOUTH
GOSNOLD
TISBURY
OAK BLUFFS
WEST TISBURY
EDGARTOWN
CHILMARK
GAY HEAD
NANTUCKET
LOCATION MAP
5 0 5 Miles
1-12,796



Hyannis, Massachusetts: Charter boats and private pleasure craft put out on deep sea fishing excursions from the docks and marinas of this Cape Cod resort.


FIGURE 5.5
AVERAGE ANNUAL GROWING SEASON (DAYS)
180
160
200
220
190
MASSACHUSETTS BAY
OCEAN
CAPE COD BAY
NANTUCKET SOUND
RHODE ISLAND
NEWBURYPORT
NEWBURY
GROVELAND
GEORGETOWN
ROWLEY
BOXFORD
IPSWICH
NORTH ANDOVER
TOPSFIELD
HAMILTON
ESSEX
ROCKPORT
GLOUCESTER
MIDDLETON
WENHAM
MANCHESTER
DANVERS
BEVERLY
NORTH READING
WILMINGTON
LYNNFIELD
READING
REABODY
WAKEFIELD
SALEM
MARBLEHEAD
WOBURN
STONEHAM
SAUGUS
LYNN
SWAMPSCOTT
WINCHESTER
MELROSE
NAHANT
MEDFORD
MALDEN
REVERE
EVERETT
CHELSEA
WINTHROP
BOSTON
HULL
DEDHAM
MILTON
QUINCY
COHASSET
WESTWOOD
HINGHAM
BRAINTREE
SCITUATE
MORWOOD
CANTON
RANDOLPH
NORWELL
WALPOLE
STOUGHTON
AVON
ROCKLAND
HANOVER
MARSHFIELD
SHARON
ABINGTON
BROCKTON
WHITMAN
HANSON
PEMBROKE
FOXBOROUGH
DUXBURY
EASTON
WEST BRIDGEWATER
EAST BRIDGEWATER
PLAINVILLE
MANSFIELD
NORTH ATTLEBOROUGH
HALIFAX
KINGSTON
NORTON
BRIDGEWATER
PLYMPTON
ATTLEBORO
RAYNHAM
TAUNTON
MIDDLEBOROUGH
CARVER
PLYMOUTH
REHOBOTH
SEEKONK
BERKLEY
DIGHTON
LAKEVILLE
WAREHAM
SWANSEA
FREETOWN
ROCHESTER
FALL RIVER
ACUSHNET
MARION
BOURNE
SANDWICH
MATTAPOISETT
NEW BEDFORD
FAIRHAVEN
BARNSTABLE
YARMOUTH
DENNIS
MARWICH
CHATHAM
BREWSTER
ORLEANS
EASTHAM
WELLFLEET
TRURO
PROVINCETOWN
MASHPEE
WESTPORT
DARTMOUTH
FALMOUTH
GOSNOLD
TISBURY
OAK BLUFFS
WEST TISBURY
EDGARTOWN
CHILMARK
GAY HEAD
MANTUCKET
BRISTOL COUNTY
PLYMOUTH COUNTY
NORFOLK COUNTY
SUFFOLK COUNTY
ESSEX COUNTY
DUKES COUNTY
NANTUCKET COUNTY
BARNSTABLE COUNTY
WITCHCRAFT CHANNEL
LOCATION MAP
5 0 5 Miles
1-12,797

August 1954, August 1955, and September 1960. In addition, major non-hurricane storms occurred in November 1944, November 1953, March 1963, and March 1968.

Droughts have occurred in the region, with the longest in recent memory extending from 1962 to 1967.

Stream gage data from USGS stations throughout the region is abstracted in Table 5.1.

5.2 LAND USE

A. Agricultural Land

Land use in the Coastal Region is dominated by forest and urban land uses which comprise nearly 75 percent of the total acreage. About 6 percent of the area is in agricultural use, while water, wetlands, and other land uses make up the balance.

In the 20-year period between 1951 and 1971, significant land use changes occurred. Agricultural land decreased by slightly more than 100,000 acres (47.6 percent). In 1951, 12.4 percent of the area was in agricultural use; by 1971, only 6.4 percent was in such use. On the other hand, urban land uses went from 200,191 acres in 1951 (11.9 percent of the area), to 345,253 acres in 1971 (20.6 percent of the area), an increase of 145,062 acres, representing a 72.5-percent gain. Of the three subregions, the Cape Cod-Islands area showed the most significant changes. Table 5.2 summarizes these changes. There are indications that the rate of decline in agricultural land may have decreased in some areas of the region during the 1970s. Dukes County appears to be a specific case where agricultural land may have actually increased in the 1969-1974 period.

TABLE 5.2 - LAND USE CHANGES, 1951 - 1971

Area	Agricultural Land		Urban Land		Forestland	
	% Change	(AC)	% Change	(AC)	% Change	(AC)
Northeast	-60.8	- 29,938	49.2	44,096	- 8.35	-15,830
Southeast	-40.8	- 53,369	79.7	71,231	- 9.50	-54,043
Cape Cod-Islands	-62.6	- 17,862	154.7	32,845	-11.40	-38,032
Region	-48.5	-101,169	72.5	145,062	- 9.70	-97,905

SOURCE: MacConnell, et al.

TABLE 5.1 - STREAM GAGE DATA

USGS Stream Gage No.	Location	Drainage Area sq. mi.	Period of Record	Average Flow (cfs)	Minimum Flow (cfs)	Date	Maximum Flow cfs	Maximum Flow csm	Date
	-Parker River Basin-								
01101000	Parker River @ Byfield	21.6	1945-present	35.7	.09	10/ 6/57	489	22.6	3/19/68
	-Ipswich River Basin-								
01101300	Maple Brook @ Wilmington	3.99	10/62 - 9/74	7.32	0	Many	119	29.8	3/19/68
01101500	Ipswich River @ S. Middleton	43.4	6/38 - present	70.8	.003	10/ 1/57	833	19.2	3/19/68
01102000	Ipswich River near Ipswich	124	6/30 - present	201	.023	8/20/65	2680	21.6	3/20/68
	-Mystic River Basin-								
01102500	Aberjona River @ Winchester	24.2	4/39 - present	27.4	.25	10/10/50	835	34.5	8/19/55
	-Neponset River Basin-								
01105000	Neponset River @ Norwood	35.2	10/39 - present	52.6	1.4	10/20/63	1490	42.3	8/19/55
01105500	E. Branch Neponset @ Canton	27.2	10/52 - present	51.3	.6	9/ 1/57	1790	65.8	8/19/55
	-Weymouth Back River Basin-								
01105600	Old Swamp River @ S. Weymouth	4.25	5/66 - present	9.81	.11	9/10/71	566	132	3/18/68
	-North River Basin-								
01105730	Indian River @ Hanover	30.3	7/66 - present	63.7	.23	7/14/71	1390	45.8	3/18/68
	-Jones River Basin-								
01105870	Jones River @ Kingston	15.8	8/66 - present	32.9	.59	8/11/66	575	36.3	3/19/68
	-Herring River Basin-								
01105880	Herring River @ North Harwich	9.4	6/66 - present	11.0	.85	10/ 9/66	59	6.3	9/ 3/72
	-Taunton River Basin-								
01107000	Dorchester Brook near Brockton	4.7	10/62 - 9/74	8.3	0	9/ 9/64	359	76.4	3/18/68
01108000	Taunton River near Bridgewater	260	10/29 - present	485	8	9/10/44	4980	19.2	3/20/68
01108500	Wading River @ West Mansfield	19.2	10/53 - present	34.7	0 1/	10/24/57	541	28.2	3/19/68
01109000	Wading River near Norton	42.4	6/52 - present	72.7	.3	9/10/76	1460	34.4	3/19/68
01109060	Threemile River @ North Dighton	83.8	7/66 - present	169	5.3	8/27/74	2490	29.7	3/19/68
01109070	Segreganset River near Dighton	10.6	7/66 - present	22.3	0	8/30/74	867	81.8	3/18/68
	-Palmer River Basin-								
01109200	West Branch Palmer River near Rehoboth	4.34	10/62 - 9/74	8.3	0	1974	441	101.6	3/18/68

1/ Caused by upstream storage.

Table 5.3 summarizes the land resource base in the region and the shares of each land use category to the total land base by each subregion for the years 1951 and 1971. It is important to note that the "other" land use category is composed of the following subcategories, as presented by MacConnell, et al.:

1. Abandoned fields, most of which are reverting to forestland or scrub brush;

2. abandoned fruit orchards;

3. gas, telephone, oil, or power line rights-of-way 100 feet or more wide maintained through wooded areas;

4. mining and waste disposal areas;

5. open or undeveloped land which is in the midst of or adjacent to urban areas; and

6. lands used for recreational purposes.

In 1971, there were 139,875 acres within the other land use category. Over 47,000 of these acres were either in abandoned fields or orchards (In 1951, there were slightly more than 57,500 acres in abandoned fields or orchards). The decrease in forestland between 1951 and 1971 would no doubt have been greater, if it were not for the fact that much land classified as "other" in 1951 had reverted to forestland by 1971.

It should be noted that, when looking at the changes that have occurred, caution should be used. For example, increases in water acreage were due in part to the installation of water impoundments, but more accurate analysis of the 1971 aerial photos also explains some of the increase. Minimum size of plots categorized in 1951 was 10 acres; in 1971, the minimum size was decreased to 3 acres. Thus, certain rivers and streams that were categorized as something other than water in 1951 were categorized as water in 1971.

The wetland category also poses a problem in that in 1951, beaver ponds seasonally flooded flats and bogs were categorized as the dominant adjacent land use. In 1971, however, they were included within the wetland category. In both years of analysis, wooded swamps were included as forestland, since photo interpretation precluded doing otherwise. Thus, the wetland category should be considered as open wetlands. The changes as listed in Table 5.3 should not be taken as gospel, but simply suggest the trends that have occurred in the land base for the twenty-year period.

In terms of acreage changes, the most significant categories are agricultural land and urban land. As Table 5.2 shows, agricultural land decreased 101,169 acres, a drop of nearly 48 percent. When it is considered that Massachusetts now imports approximately 85 percent of its food, a continuation of this trend is a rather disturbing thought. Much

TABLE 5.3 LAND USE, 1950 AND 1970

	Cropland 1	Pasture 2	Agricultural Land 1 + 2	Forest 3	Wetland 4	Water 5	Industrial/ Commercial 6	Residential 7	Insti- tutional 8	Urban 6+7+8	Other 9	Total 10
Northeast												
1950	20,883	28,324	49,207	189,560	34,652	14,368	14,752	68,803	6,059	89,614	24,208	401,609
1970	10,846	8,423	19,269	173,730	26,709	19,192	24,871	95,852	8,877	129,600	33,109	401,609
Change in Acres	-10,037	-19,901	-29,938	-15,830	-7,943	4,824	10,119	27,049	2,818	44,096	8,901	
1950 Share (%)	5.2	7.1	12.3	47.2	8.6	3.6	3.7	17.1	1.5	22.3	6.0	
1970 Share (%)	2.7	2.1	4.8	43.3	6.7	4.8	6.2	23.9	2.2	32.3	8.2	
% Change in Share	-2.5	-5.0	-7.5	-3.9	-1.9	1.2	2.5	6.8	0.7	10.0	2.2	
Southeast												
1950	57,965	72,743	130,708	571,544	40,448	30,818	8,672	76,386	4,288	89,346	28,770	891,634
1970	54,326	23,013	77,339	517,501	33,437	41,781	28,180	125,346	8,051	161,577	59,999	891,634
Change in Acres	-3,639	-49,730	-53,369	-54,043	-7,011	10,963	19,508	48,960	3,763	72,231	31,229	
1950 Share (%)	6.5	8.2	14.7	64.1	4.5	3.5	1.0	8.6	0.5	10.0	3.2	
1970 Share (%)	6.1	2.6	8.7	58.0	3.8	4.7	3.2	14.1	0.9	18.1	6.7	
% Change in Share	-0.4	-5.6	-6.0	-6.1	-0.7	1.2	2.2	5.5	0.4	8.0	3.5	
Cape Cod/Islands												
1950	12,404	16,152	28,556	245,064	22,573	31,424	1,839	17,441	1,951	21,231	37,649	386,497
1970	7,645	3,049	10,694	217,032	23,054	34,874	6,865	44,311	2,900	54,076	46,767	386,497
Change in Acres	-4,759	-13,103	-17,862	-28,032	481	3,450	5,026	26,870	949	32,845	9,118	
1950 Share (%)	3.2	4.2	7.4	63.4	5.8	8.1	0.5	4.5	0.5	5.5	9.7	
1970 Share (%)	2.0	0.8	2.8	56.2	6.0	9.0	1.8	11.5	0.8	14.0	12.1	
% Change in Share	-1.2	-3.4	-4.6	-7.2	0.2	0.9	1.3	7.0	0.3	8.5	2.4	
Coastal Region												
1950	91,252	117,219	208,471	1,006,168	97,673	76,610	25,263	162,630	12,298	200,191	90,627	1,679,740
1970	72,817	34,485	107,302	908,263	83,200	95,847	59,916	265,509	19,828	345,253	139,875	1,679,740
Change in Acres	-18,435	-82,734	-101,169	-97,905	-14,473	19,237	34,653	102,879	7,530	145,062	49,248	
1950 Share (%)	5.4	7.0	12.4	59.9	5.8	4.6	1.5	9.7	0.7	11.9	5.4	
1970 Share (%)	4.3	2.1	6.4	54.1	5.0	5.7	3.6	15.8	1.2	20.6	8.3	
% Change in Share	-1.1	-4.9	-6.0	-5.8	-0.8	1.1	2.1	6.1	0.5	8.7	2.9	

Percentage totals may not add to 100 percent due to rounding.

of the former agricultural acreage has gone into urban uses. From an agricultural perspective, although the actual conversion acreage may not be that large, there are a number of important ramifications.

From an economic viewpoint, agricultural earnings, while amounting to over $200 million, are quite insignificant relative to the total earnings in the state. Agricultural pursuits employ less than one percent of the labor force and contribute comparably to total personal income. It should be noted, however, when agricultural enterprises are considered within the goals and objectives of local or regional planning groups, the simple economic viewpoint is inadequate.

There are a number of factors which appear to aggravate the continuing decrease in agricultural land:

1. Zoning ordinances--towns in the region have zoned agricultural land to permit residential use and, in some cases, industrial and commercial use. Most zoning regulations incorporate an implicit assumption that farming is a residual or temporary use which will be replaced by nonagricultural uses, and zoning often is in direct opposition to the land use objective of agricultural land preservation.

   Section 81 of Chapter 41, General Laws, stipulates that for any development which will be placed upon frontage along already existing public roads, subdivision review is not required. Although recently introduced legislation has a requirement that any development on more than two lots would require subdivision approval, the fact that there is no minimum time frame incorporated into the act somewhat diminishes its potential impact.[5/] The result is a large degree of strip development which creates the most expensive pattern for public services. Such development patterns also maximize the potential encroachment on agricultural land. For example, as development continues, farmer field operations taking place behind the strip may be subject to nuisance ordinances forced on the operator by the new residents who wield more political power. The indirect and direct impacts of zoning regulations seem to be opposed to the professed intent of preserving agriculture.

2. Relative to competing agricultural areas, especially those in truck farm type crops, Massachusetts' climate provides a relatively short growing season. When that factor is amalgamated with the distribution of soil groups, size of holdings, and labor costs, a negative comparative advantage results. As Christensen pointed out, nearly three million acres were cleared and used for agriculture in 1860. Today most of this land is now growing trees. But even if this former cropland was brought back into production, the resulting food costs would be higher than they now are because of the expense of working the land and the relatively low yields:

"Plowing and tilling an acre of stony land has a much higher cost than plowing an acre of nonstony land and, when this extra cost is combined with lower yields, the resulting food produced has a high production cost per unit of yield."[6/]

3. A third factor that helps explain the loss of agricultural land is the fact that there are very few storage facilities in the state; thus, the advantages of bulk shipping from the food and feed crop exporting areas cannot be gained. As a result, the unit cost of transporting the necessary productive inputs are high and, consequently, the cost of raising livestock and crops are higher than in those areas which have adequate storage facilities.

   For example, in 1945, poultry production was the most important source of farm income in Massachusetts (38.1 percent), as compared to 1974 when it amounted to about 13 percent of the value of agricultural production. This decline was brought about by the vast expansion of poultry enterprises in the DelMarVa Peninsula and areas farther south. The climatic difference is such that corn and soybeans, the major feed ingredients, grow prolifically in these southern areas. When there are inadequacies in cropland area, the presence of large storage facilities permit the bulk transportation of feed at minimal costs. As a result, the poultry areas of the south now produce chickens at a lower cost, while equalling or exceeding the quality of the Massachusetts poultry product.

4. A fourth reason which explains the loss of agricultural land is twofold: higher transportation rates and the lack of a coordinated marketing system. As Platt et al. diagrammed, Franklin and Hampshire Counties are the major agricultural areas in the state.

   Most of this area bordering the Connecticut River is in vegetable crop production. But the lack of consistent product quality tied with a sporadic supply schedule has prevented the development of a vegetable processing industry or a well coordinated fresh-market system. As a result, other regions like Florida and California, with their longer growing seasons, greater crop varieties, and modern processing plants, supply a great deal of the fresh and processed vegetable products used by Massachusetts consumers.

In discussing the resource base, it is necessary to incorporate existing and potential legislation, in order to determine how these laws will affect the future resource base.

As a step in curbing the loss of agricultural land, the Massachusetts General Court enacted Chapter 61A in 1973, an act providing for the assessment of agricultural or horticultural land at a value based upon its agricultural or horticultural uses. Although a rigorous assessment of the impact of this act has not been undertaken, the general consensus is that it has been of minimal effectiveness in

curbing the loss of agricultural land. The primary explanation for this result is that there was defacto agricultural assessment prior to the passage of the act. As Barlowe and Alter stated:

> "How far use-value assessment programs can go in protecting agricultural and open space land depends largely on the emphasis given to the current use-protection objective. Landowners have a natural economic incentive for favoring taxing arrangements that provide them with benefits and still leave them with the option of developing or selling their lands. A protection policy, in contrast, calls for tight declassification procedures that discourage or prevent withdrawals once lands have been accepted for (agricultural assessment) classification.
>
> "These two objectives are in conflict. Programs that emphasize the first objective provide little protection for existing land uses while those that emphasize the protection goal offer little incentive for owner participation. Considerable emphasis has been given to protectionist goals in several laws enacted in the past decade, but even the most restrictive of these involves elements of compromise between the two objectives.
>
> "Recognition of these factors prompts the conclusion that, by itself, use-value assessment cannot provide more than a partial answer to the farmland and open space preservation problem. Its chief merit lies in the role it can play in buying time, particularly in semi-rural areas, for state and local governments to seek and enact supplemental programs to protect agricultural and open space lands."7/

Defacto agricultural assessment has precluded the agricultural assessment act from being an effective means, whereby agricultural and horticultural lands could be preserved. However, the situation has recently changed, since each city and town must assess property values at 100 percent of market value. Such an assessment would preclude defacto assessments; therefore, the potential effectiveness of the agricultural assessment act may increase substantially.

To further the potential of agricultural preservation, the General Court first enacted a development rights bill which enables cities and towns to purchase the development rights to agricultural land.

No state funding was approved for this program and, unless arrangements are made for cost sharing, the future effectiveness of the development rights program appeared to be minimal. In 1977, the legislature passed Chapter 780, The Agricultural Restriction Program, establishing a state-run pilot program to acquire development rights. The program depends on cooperation of local conservation commissions and can be used in conjunction with the earlier act authorizing local purchase of development rights.

The effectiveness of a development rights program is somewhat limited, as land is only one of many productive inputs. In a recent investigation trying to explain the loss of agricultural land, the variables having to do with increased population growth, increasing taxes, and increased urbanization were insufficient to explain the loss. This strongly suggests that the agricultural demise results from low net income to the agricultural community. To the extent that the development rights program supplies additional capital to the farmers and, such capital is invested in cost reducing measures, the development rights program may have some impact.

B. Agricultural Land Study

The U.S. Department of Agriculture is concerned about any action that tends to impair the productive capacity of American agriculture. The continuing loss of farmland in the Coastal Region is such an action. Nationwide, the SCS has a Land Inventory and Monitoring Program to make and keep current an inventory of the prime farmland and unique farmland. Farmlands that are of statewide or local importance for producing crops are also identified. The nation needs to know the extent and location of the best land for producing food, feed, fiber, and forage.

The first phase of the farmland inventory is being conducted in those counties which have published soil surveys available. In the Coastal Region, Plymouth County meets this criteria.[8/]

Three categories of farmland are being inventoried:

1. Prime Farmland--Prime farmland is land best suited for producing food, feed, forage, and fiber; and also available for these uses (the land could be cropland, pastureland, rangeland, forestland, or other land, but not urban, builtup land, or water). It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods.

2. Unique Farmland--Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods. Examples of such crops in Massachusetts are cranberries and orchard fruit and grapes now in production on Martha's Vineyard.

   Unique farmland has the following characteristics:

   a. It is used for a specific high-value food or fiber crop;

b. it has a moisture supply that is adequate for the specific crop; the supply is from stored moisture, precipitation, or a developed irrigation system;

c. it combines favorable factors of soil quality, growing season, temperature, humidity, air drainage, elevation, aspect, or other conditions, such as nearness to market, that favor the growth of a specific food or fiber crop.

3. Additional Farmland of Statewide and Local Importance--This is land, in addition to prime and unique farmlands, that is of statewide and local importance for the production of food, feed, fiber, and forage crops. Criteria for defining and delineating this land are to be determined by state and local personnel familiar with the specific needs of the region. These lands include some of those commonly utilized for pasture and hay.

Results of the Land Inventory and Monitoring Program for farmland in Plymouth County is expected to be available in late 1978.

To illustrate the dramatic irreversible loss of farmland in the Coastal Region, the Massachusetts Water Resources Study has analyzed data for 21 towns. Basic data was prepared in a manner which can make it useful to a variety of state and local agencies in efforts to protect existing farmland.

Towns were selected to represent a geographic distribution in the region. A prerequisite for inclusion of a town was the availability of a published soil survey for the community. Communities selected are shown on Figure 5.6.

Plymouth County towns were omitted from this study to avoid duplicating much of the results to be derived from the Land Inventory and Monitoring Program. The urban core surrounding Boston was also omitted because of the intense urbanization of that area.

A base map for the community was prepared at scale 1:24,000 (1 inch = 2,000 feet), using the U.S. Geological Survey topographic maps. Detailed soils data was adjusted to the base map and a transparent mylar overlay of the detailed soils map prepared. Another mylar overlay was constructed which indicated all prime farmland and farmland of state and local importance.

Using a transparent copy of this farmland soils overlay, land use data was added, using the 1971 Massachusetts Map Down maps. Existing farming was mapped wherever it occurred in the town. In addition, land uses were mapped for all areas of farmland soil.

The data contained in this combined farmland soils-land use overlay was measured and summarized. Results are presented in Tables 5.4 through 5-8. Some interesting conclusions can be drawn from this study of farmland in the region.

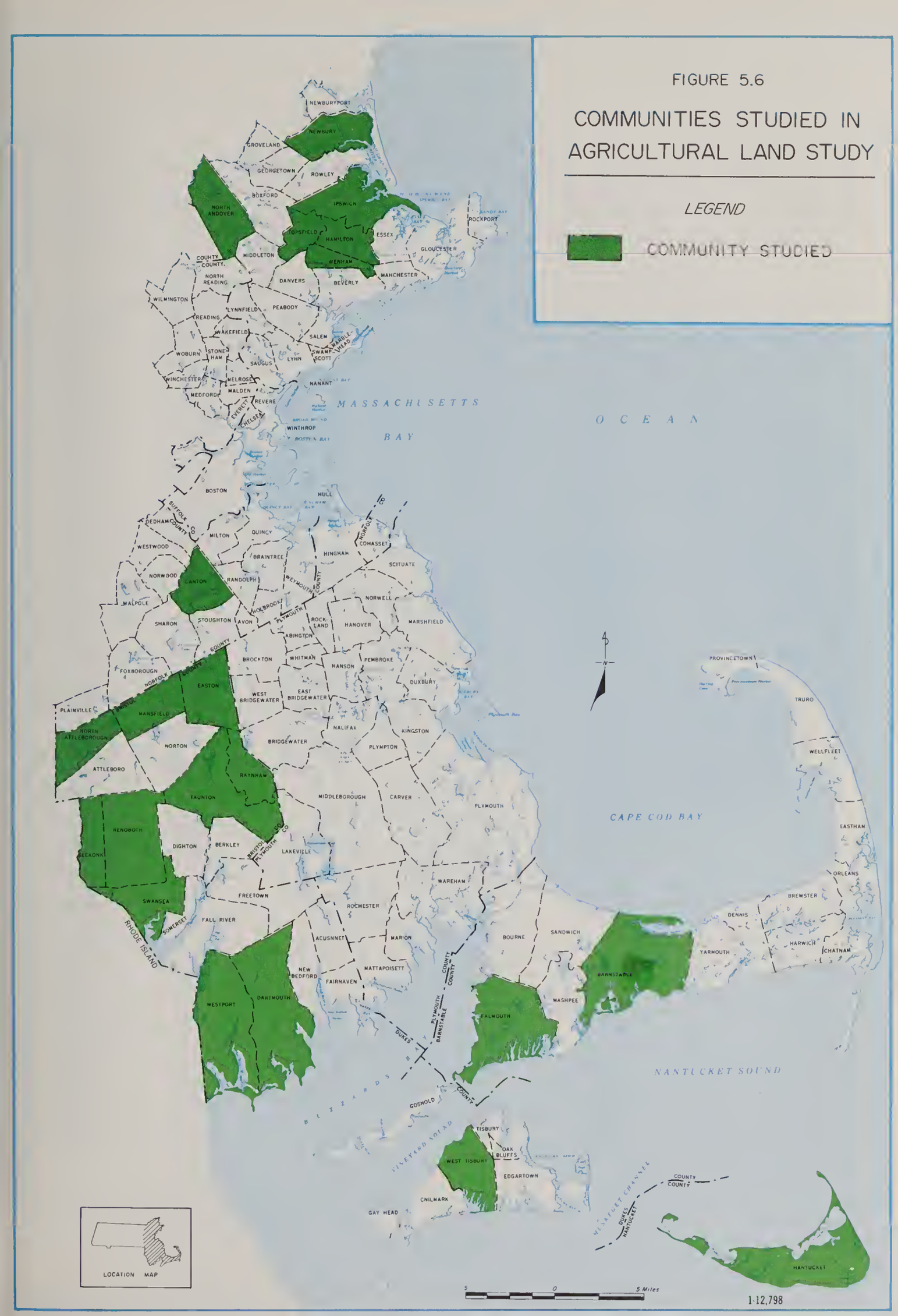

FIGURE 5.6
COMMUNITIES STUDIED IN AGRICULTURAL LAND STUDY
LEGEND
COMMUNITY STUDIED
NEWBURYPORT
NEWBURY
GROVELAND
GEORGETOWN
ROWLEY
BOXFORD
NORTH ANDOVER
IPSWICH
TOPSFIELD
HAMILTON
ESSEX
ROCKPORT
GLOUCESTER
MIDDLETON
WENHAM
MANCHESTER
DANVERS
BEVERLY
NORTH READING
WILMINGTON
LYNNFIELD
PEABODY
READING
WAKEFIELD
SALEM
MARBLEHEAD
WOBURN
STONEHAM
SAUGUS
LYNN
SWAMPSCOTT
WINCHESTER
MELROSE
MALDEN
NAHANT
MEDFORD
REVERE
EVERETT
CHELSEA
WINTHROP
MASSACHUSETTS BAY
OCEAN
BOSTON
HULL
SUFFOLK CO
DEDHAM
MILTON
QUINCY
NORFOLK
COHASSET
WESTWOOD
BRAINTREE
HINGHAM
SCITUATE
NORWOOD
CANTON
RANDOLPH
WEYMOUTH
NORWELL
WALPOLE
NORFOLK COUNTY
PLYMOUTH COUNTY
SHARON
STOUGHTON
AVON
ROCKLAND
HANOVER
MARSHFIELD
ABINGTON
BRISTOL COUNTY
BROCKTON
WHITMAN
HANSON
PEMBROKE
FOXBOROUGH
DUXBURY
EASTON
WEST BRIDGEWATER
EAST BRIDGEWATER
PLAINVILLE
MANSFIELD
NORTH ATTLEBOROUGH
HALIFAX
KINGSTON
BRIDGEWATER
PLYMPTON
NORTON
ATTLEBORO
RAYNHAM
TAUNTON
MIDDLEBOROUGH
CARVER
PLYMOUTH
RENOBOTH
DIGHTON
BERKLEY
BRISTOL CO
PLYMOUTH CO
LAKEVILLE
SEEKONK
WAREHAM
FREETOWN
SWANSEA
ROCHESTER
SOMERSET
FALL RIVER
RHODE ISLAND
ACUSHNET
MARION
BOURNE
SANDWICH
NEW BEDFORD
MATTAPOISETT
FAIRHAVEN
BARNSTABLE COUNTY
WESTPORT
DARTMOUTH
MASHPEE
FALMOUTH
DUKES
PROVINCETOWN
TRURO
WELLFLEET
CAPE COD BAY
EASTHAM
ORLEANS
BREWSTER
DENNIS
HARWICH
CHATHAM
YARMOUTH
BARNSTABLE
NANTUCKET SOUND
GOSNOLD
BLIZZARDS
TISBURY
OAK BLUFFS
VINEYARD SOUND
WEST TISBURY
EDGARTOWN
CHILMARK
GAY HEAD
NANTUCKET SOUND
COUNTY
NANTUCKET
HANTUCKET
LOCATION MAP
5 0 5 Miles
1-12,798

TABLE 5.4 EXISTING FARMLAND

Community	Cropland	Pasture	Orchard	Cranberry Bog	Total
	Acres (Percent of Town Area)				
Barnstable	534 (1.6)	553 (1.6)	3 -	447 (1.3)	1537 (4.5)
Canton	310 (2.6)	112 (1)	0	0	422 (3.5)
Dartmouth	2650 (7.3)	2487 (6.9)	41 (0.1)	54 (0.1)	5232 (14.4)
Easton	337 (1.8)	919 (5)	3 -	75 (0.4)	1334 (7.3)
Falmouth	669 (2.4)	306 (1.1)	0	296 (1.1)	1271 (4.6)
Hamilton	300 (3.2)	834 (9)	11 (0.1)	0	1145 (12.3)
Ipswich	741 (4.4)	1485 (8.9)	78 (0.5)	0	2304 (13.7)
Mansfield	720 (5.6)	89 (0.7)	3 -	0	812 (6.3)
Nantucket	409 (1.4)	434 (1.5)	0	342 (1.2)	1185 (4)
Newbury	1160 (10.8)	728 (6.8)	11 (0.1)	0	1899 (17.8)
North Andover	859 (5)	877 (5.1)	93 (0.5)	0	1829 (10.7)
North Attleborough	1462 (11.9)	187 (1.5)	0	0	1649 (13.4)
Raynham	533 (4.1)	865 (6.7)	6 -	25 (0.2)	1429 (11)
Rehoboth	3527 (11.7)	931 (3.1)	19 (0.1)	0	4477 (14.8)
Seekonk	1749 (14.6)	327 (2.7)	8 (0.1)	0	2084 (17.3)
Swansea	1885 (13.4)	337 (2.4)	65 (0.5)	0	2287 (16.3)
Taunton	1276 (4.4)	1316 (4.6)	3 -	88 (0.3)	2683 (9.3)
Topsfield	486 (6)	397 (4.9)	15 (0.2)	0	898 (11.1)
Wenham	223 (4.4)	329 (6.5)	15 (0.3)	0	567 (11.2)
Westport	4655 (14.8)	636 (2)	22 (0.1)	0	5313 (16.9)
West Tisbury	664 (4.1)	166 (1)	0	0	830 (5.2)

TABLE 5.5 PRIME FARMLAND SOILS

Community	Land Use						
	Cropland	Pasture	Orchard	Forest	Available	Urban	Total*
	Acres (Percent of Prime Soils in this Land Use)						
Barnstable	78 (2.1)	134 (3.7)	0	2638 (72.1)	186 (5.1)	662 (17.0)	3658 (10.6)
Canton	192 (14.0)	15 (1.1)	0	396 (28.7)	86 (6.2)	689 (50.0)	1378 (11.4)
Dartmouth	1494 (24.4)	1319 (21.5)	22 (0.4)	1194 (19.5)	285 (4.7)	1810 (29.6)	6124 (16.9)
Easton	124 (5.4)	266 (11.5)	0	1128 (48.8)	184 (8.0)	608 (26.3)	2310 (12.7)
Falmouth	511 (10.3)	152 (3.1)	0	2921 (58.9)	576 (11.6)	800 (16.1)	4960 (17.9)
Hamilton	183 (6.8)	449 (16.7)	11 (0.4)	1100 (41.0)	69 (2.6)	870 (32.4)	2682 (28.9)
Ipswich	386 (9.6)	752 (18.7)	73 (1.8)	1511 (37.6)	424 (10.6)	868 (21.6)	4014 (23.9)
Mansfield	204 (12.6)	37 (2.3)	3 (0.2)	681 (42.1)	101 (6.2)	592 (36.6)	1618 (12.6)
Nantucket	137 (3.4)	55 (1.4)	0	1133 (28.4)	1836 (46.1)	823 (20.7)	3984 (13.4)
Newbury	561 (36.4)	243 (15.8)	8 (0.5)	463 (30.1)	95 (6.2)	169 (11.0)	1539 (14.4)
N. Andover	347 (13.1)	286 (10.8)	18 (0.7)	576 (21.8)	160 (6.0)	1261 (47.6)	2648 (15.5)
North Attleborough	541 (44.7)	8 (0.7)	0	363 (30.0)	47 (3.9)	250 (20.7)	1209 (9.8)
Raynham	108 (12.0)	100 (11.1)	0	486 (54.1)	48 (5.3)	156 (17.4)	898 (6.9)
Rehoboth	1132 (33.1)	139 (4.1)	9 (0.3)	1563 (45.7)	173 (5.1)	407 (11.9)	3423 (11.3)
Seekonk	536 (39.8)	46 (3.4)	0	227 (16.7)	76 (5.6)	461 (34.2)	1346 (11.2)
Swansea	539 (29.2)	38 (2.1)	24 (1.3)	256 (13.9)	72 (3.9)	915 (49.6)	1844 (13.1)
Taunton	180 (12.5)	337 (23.4)	3 (0.2)	613 (42.6)	117 (8.1)	189 (13.1)	1439 (5)
Topsfield	249 (14.7)	194 (11.4)	10 (0.6)	688 (40.6)	125 (7.4)	429 (25.3)	1695 (20.9)
Wenham	138 (13.9)	163 (16.4)	3 (0.3)	331 (33.3)	32 (3.2)	326 (32.8)	993 (19.6)
Westport	2408 (63.0)	85 (2.2)	0	464 (12.1)	126 (3.3)	741 (19.4)	3824 (12.2)
West Tisbury	428 (6.9)	72 (1.2)	0	5117 (82.1)	474 (7.6)	142 (2.3)	6233 (39.0)

*Percent of the town in Prime Farmland Soil.

TABLE 5.6 SOILS OF STATE AND LOCAL IMPORTANCE FOR FARMING

Community	Land Use						
	Cropland	Pasture	Orchard	Forest	Available	Urban	Total*
	Acres (Percent of State and Local Important Soils in this Use)						
Barnstable	240 (3.2)	168 (2.2)	0	5040 (67.3)	491 (6.6)	1529 (20.5)	7468 (21.7)
Canton	51 (2.4)	34 (1.6)	0	987 (47.4)	109 (5.2)	901 (43.3)	2082 (17.3)
Dartmouth	394 (5.8)	364 (5.3)	2 (0)	4238 (62.1)	398 (5.8)	1427 (20.9)	6823 (18.8)
Easton	75 (1.8)	197 (4.8)	0	2627 (63.7)	192 (4.7)	1030 (25.0)	4121 (22.6)
Falmouth	111 (2.5)	93 (2.1)	0	2533 (56.2)	334 (7.4)	1437 (31.9)	4508 (16.2)
Hamilton	64 (3.1)	225 (10.8)	0	1306 (62.7)	45 (2.2)	444 (21.3)	2084 (22.5)
Ipswich	241 (6.2)	257 (6.7)	3 (0.1)	2305 (59.8)	234 (6.1)	814 (21.1)	3854 (23.0)
Mansfield	98 (5.1)	8 (0.4)	0	1447 (76.0)	39 (2.0)	312 (16.4)	1904 (14.8)
Nantucket	2 (0.2)	8 (1.0)	0	592 (71.1)	178 (21.4)	53 (6.4)	833 (2.8)
Newbury	223 (24.0)	71 (7.6)	0	296 (31.9)	91 (9.8)	247 (26.6)	928 (8.7)
N. Andover	248 (6.6)	233 (6.2)	45 (1.2)	2305 (61.6)	148 (4.0)	763 (20.4)	3742 (21.9)
North Attleborough	287 (9.8)	47 (1.6)	0	1871 (63.8)	124 (4.2)	604 (20.6)	2933 (23.9)
Raynham	172 (4.0)	389 (9.0)	5 (0.1)	2717 (63.0)	207 (4.8)	826 (19.1)	4316 (33.3)
Rehoboth	1146 (24.2)	209 (4.4)	5 (0.1)	2459 (51.9)	279 (5.9)	635 (13.4)	4728 (15.6)
Seekonk	595 (20.8)	124 (4.3)	7 (0.2)	1131 (39.5)	225 (7.9)	781 (27.2)	2863 (23.8)
Swansea	619 (17.8)	98 (2.8)	38 (1.1)	1636 (47.0)	282 (8.1)	805 (23.1)	3478 (24.8)
Taunton	636 (6.7)	489 (5.2)	0	5519 (58.6)	600 (6.4)	2182 (23.1)	9426 (32.6)
Topsfield	142 (5.2)	117 (4.3)	2 (0.1)	1617 (59.5)	126 (4.6)	712 (26.2)	2716 (33.5)
Wenham	57 (5.5)	101 (9.7)	3 (0.3)	443 (42.4)	29 (2.8)	411 (39.4)	1044 (20.6)
Westport	1260 (14.4)	22 (0.3)	11 (0.1)	5720 (65.2)	459 (5.2)	1297 (14.8)	8769 (27.9)
West Tisbury	80 (3.2)	55 (2.2)	0	2191 (88.5)	100 (4.0)	51 (2.1)	2477 (15.5)

*Percent of Town in Soils of State and Local Importance for Farming.

TABLE 5.7 PRIME FARMLAND SOILS AND SOILS OF STATE AND LOCAL IMPORTANCE FOR FARMING

Community	Land Use						
	Cropland	Pasture	Orchard	Forest	Available	Urban	Total
	Acres (Percent of Prime Farmland Soils and Soils of State and Local Importance in this Land Use)						
Barnstable	318 (2.9)	302 (2.7)	0	7678 (69.0)	677 (6.1)	2151 (19.3)	11,126 (32.3)
Canton	243 (7.0)	49 (1.4)	0	1383 (40.0)	195 (5.6)	1590 (46.0)	3,460 (28.7)
Dartmouth	1888 (14.6)	1683 (13.0)	24 (0.2)	5432 (42.0)	683 (5.3)	3237 (25.0)	12,947 (35.7)
Easton	199 (3.1)	463 (7.2)	0	3755 (58.4)	376 (5.8)	1638 (25.5)	6,431 (35.3)
Falmouth	622 (6.6)	245 (2.6)	0	5454 (57.6)	910 (9.6)	2237 (23.6)	9,468 (34.1)
Hamilton	247 (5.2)	674 (14.1)	11 (0.2)	2406 (50.5)	114 (2.4)	1314 (27.6)	4,766 (51.5)
Ipswich	627 (8.0)	1009 (12.8)	76 (1.0)	3816 (48.5)	658 (8.4)	1682 (21.4)	7,868 (46.9)
Mansfield	302 (8.6)	45 (1.3)	3 (0.1)	2128 (60.4)	140 (4.0)	904 (25.7)	3,522 (27.5)
Nantucket	139 (2.9)	63 (1.3)	0	1725 (35.8)	2014 (41.8)	876 (18.2)	4,817 (16.3)
Newbury	784 (31.8)	314 (12.7)	8 (0.3)	759 (30.8)	186 (7.5)	416 (16.9)	2,467 (23.1)
N. Andover	595 (9.3)	519 (8.1)	63 (1.0)	2881 (45.1)	308 (4.8)	2024 (31.7)	6,390 (37.4)
North Attleborough	828 (20.0)	55 (1.3)	0	2234 (53.9)	171 (4.1)	854 (20.6)	4,142 (33.7)
Raynham	280 (5.4)	489 (9.4)	5 (0.1)	3203 (61.4)	255 (4.9)	982 (18.8)	5,214 (40.3)
Rehoboth	2278 (27.9)	348 (4.3)	14 (0.2)	4017 (49.3)	452 (5.5)	1042 (12.8)	8,151 (26.9)
Seekonk	1131 (26.9)	170 (4.0)	7 (0.2)	1358 (32.3)	301 (7.2)	1242 (29.5)	4,209 (35.0)
Swansea	1158 (21.8)	136 (2.6)	62 (1.2)	1892 (35.6)	354 (6.7)	1720 (32.3)	5,322 (37.9)
Taunton	816 (7.5)	826 (7.6)	3 (0.03)	6132 (56.4)	717 (6.6)	2371 (21.8)	10,865 (37.6)
Topsfield	391 (8.9)	311 (7.1)	12 (0.3)	2305 (52.3)	251 (5.7)	1141 (25.9)	4,411 (54.4)
Wenham	195 (9.6)	264 (13.0)	6 (0.3)	774 (38.0)	61 (3.0)	737 (36.2)	2,037 (40.1)
Westport	3668 (29.1)	107 (0.8)	11 (0.09)	6184 (49.1)	585 (4.6)	2038 (16.2)	12,593 (40.1)
West Tisbury	508 (5.8)	127 (1.5)	0	7308 (83.9)	574 (6.6)	193 (2.2)	8,710 (54.4)

TABLE 5.8 "OTHER"1/ SOILS BEING FARMED

Community	Acres					Percent of Existing Farmland Located on "Other Soils"2/
	Cropland	Pasture	Orchard	Cranberry Bogs	Total	
Barnstable	216	251	3	430	900	43.1
Canton	67	63	0	0	130	30.8
Dartmouth	762	805	17	54	1638	30.6
Easton	138	456	3	75	672	47.4
Falmouth	47	63	0	296	406	11.3
Hamilton	53	160	0	0	213	18.6
Ipswich	114	476	2	0	592	25.7
Mansfield	418	44	0	0	462	56.9
Nantucket	270	371	0	342	983	76.0
Newbury	376	413	3	0	792	41.7
North Andover	264	358	30	0	652	35.6
No. Attleborough	634	132	0	0	766	46.4
Raynham	253	376	1	25	655	44.9
Rehoboth	1249	583	5	0	1837	41.0
Seekonk	618	157	1	0	776	37.2
Swansea	727	202	3	0	932	40.7
Taunton	460	490	0	88	1038	36.6
Topsfield	95	86	2	0	183	20.4
Wenham	28	65	8	0	101	17.8
Westport	987	331	11	0	1329	25.0
West Tisbury	156	39	0	0	195	23.5

1/"Other" soils are all soils except those classified as prime farmland soils or soils of state and local importance for farming.

2/Percentage excludes cranberry bogs which are unique farmlands.

First, agricultural land use represents a very small percentage of total town area. Agricultural use ranges from 17 percent of the area of Seekonk to only 4 percent for Barnstable, Falmouth, and Nantucket.

Prime farmland soils constitute less than 20 percent of most towns sampled.

In many of the towns, a small percentage of the prime farmland soils is being used for agriculture. In fact, for nearly half of the towns, the area in urban land use exceeded that in agriculture.

In over half of the towns, forestland represents the greatest land use on prime farmland soils.

For soils of state and local importance, many of the same conclusions are evident:

1. These soils constitute about 25 percent of the town area.

2. A small percentage of the land is being used for agriculture with a greater percentage used for urban land.

3. Forestland represents the greatest land use.

A surprising percentage of the existing farmland is located on soils other than prime farmland or soils of state and local importance.

It is logical to suppose that urban development has taken place on prime farmland because many of the factors which make farmland prime also make prime building land. Gentle slopes, lack of rocks, good drainage, freedom from flooding all favor development as well as farming.

The implications for potential erosion problems on the large percentage of farmland located on "other" soils cannot be ignored. These soils usually require good conservation practices to avoid excessive erosion losses. Naturally, these conservation practices add to the "cost of doing business" for the farmer.

John Foster of the Department of Food and Resource Economics, University of Massachusetts, undertook a study[9/] similar to that which has been described above. In Foster's study, a sample of 26 towns was examined to determine the changes that occurred on agricultural land between 1951 and 1971. His findings are very similar to those enumerated above: 42 percent of the better agriculture soils are in forestland because of previous reversion, and urban land is found on 12 percent of these soils. His sample of 26 towns differed somewhat in that he chose only those towns with large agricultural areas relative to urban areas. As a result, his findings showed that in 1971, intensive agriculture (tilled land, orchard and nursery uses) was found on 25 percent or 119,000 acres of the better agricultural soils in the state.

Foster also developed a data base to show how agricultural land uses changed in the state between 1951 and 1971. He delineated the 1971 acres of tilled land among three soil productivity groups: "best", "good", and "poor". Approximately half of the state's tilled land was found on soils classified as "best" for agriculture, and another third was found on moderately good soils. Between 1951 and 1971, 5,900 acres per year were lost from tilled agricultural land to non-agricultural uses. Of this amount, 1,700 acres were classified as "best" agricultural land and went into the following uses: 400 became abandoned, 900 moved into urban uses, 200 became forested, and another 200 went into other uses (primarily recreation, but also includes mining, waste disposal, and wetlands). Another 1,500 acres were classified as "good" agricultural soil and went into the following uses: 400 became abandoned, 700 went to urban uses, 200 went to forest uses, and another 200 went to other uses. A total of 56,000 acres went from tilled agricultural land of all types to urban uses between 1951 and 1971, and 32,000 acres of that amount were "best" and "good" agricultural land. In summary, almost half of the agricultural land that went into nonagricultural uses was relatively good productive agricultural land. It must also be recognized that there were 84,000 acres of best and moderate agricultural land that were abandoned between 1951 and 1971. This acreage, unless committed to another use, will also revert to forestland.

To assist communities in assessing the status of their agricultural resource base, the Soil Conservation Service can provide a limited number of transparent overlays of the data compiled for this agricultural land study. The map data can be helpful in visualizing the extent of agricultural soils, existing agricultural enterprise, and in predicting future agricultural impacts of urban growth. The maps should be useful to planning boards, zoning boards of appeal, and conservation commissions. They are especially useful to communities about to embark on measures designed to protect their agricultural resources.

To illustrate the types of data available and the scope of information contained therein, a map has been prepared for the town of North Attleborough and printed as Figure 5.7 of this report. This map is the combination of three overlays and is intended to publicize the data available in the 20-communities which were sampled. Several other combinations or permutations of the basic overlays are possible, depending on the needs of the community. Interested town officials should direct their requests to the County Conservation District.

C. Forestland

Forestland provides economic, environmental, and social benefits. These benefits are in the form of wood products, water, wildlife, forage, and recreation. The types and amounts of benefits produced from forestland are determined by the owners, subject to factors such as forest location, land productivity, and land conditions of site and soil. The owner of forestland can, for example, use his land for wood

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TOWN OF NORTH ATTLEBOROUGH
BRISTOL COUNTY, MASSACHUSETTS

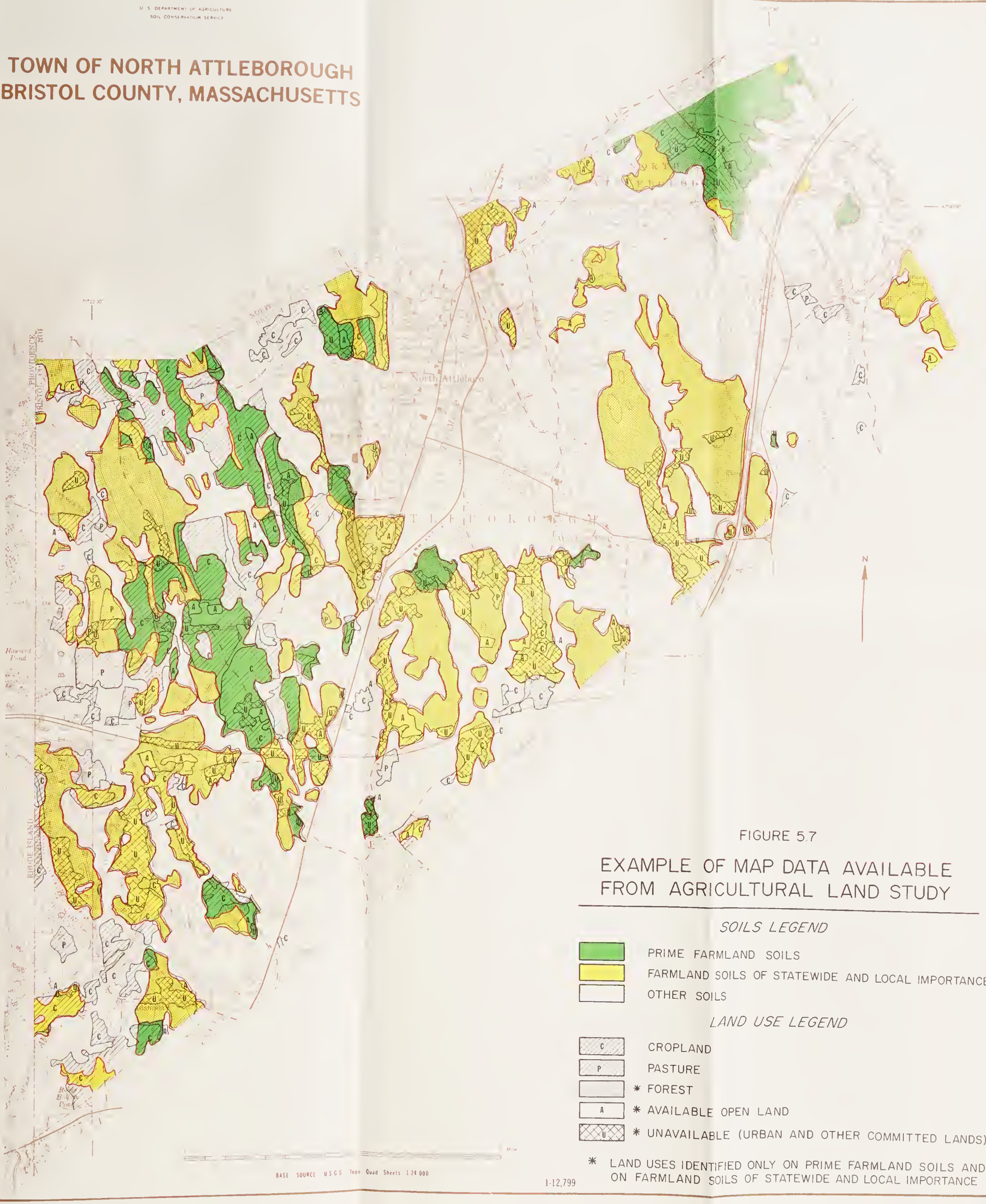


FIGURE 5.7

EXAMPLE OF MAP DATA AVAILABLE FROM AGRICULTURAL LAND STUDY

SOILS LEGEND

- PRIME FARMLAND SOILS
- FARMLAND SOILS OF STATEWIDE AND LOCAL IMPORTANCE
- OTHER SOILS

LAND USE LEGEND

- C — CROPLAND
- P — PASTURE
- * FOREST
- A — * AVAILABLE OPEN LAND
- U — * UNAVAILABLE (URBAN AND OTHER COMMITTED LANDS)

* LAND USES IDENTIFIED ONLY ON PRIME FARMLAND SOILS AND ON FARMLAND SOILS OF STATEWIDE AND LOCAL IMPORTANCE

products, forage, and recreation, and, within limitations, determine the mix of these benefits. Forest landowners can also manage their properties to enhance water and wildlife benefits, even though these benefits transcend ownership boundaries.

The ownership of forestland, the number of acres owned, and the reasons for owning forestland provide data useful to make inferences on the forestland resource base and on the potential output of benefits from forestland.

Approximately 908,000 acres are classed as forestland. Approximately 86 percent of the forestland is in private ownership, including individuals, partnerships, and corporations. Privately-owned lands are usually not open to the general public. Fourteen percent of the forestland is in public ownership. Publicly-owned lands are usually open for public use, with certain exceptions.

Most commercial forestland in the Coastal Region is in small tracts. An estimated 70 percent of the owners own 9 or fewer acres. These owners own 18 percent of the total acres. Ninety-four percent of the owners own 49 or fewer acres. These owners own 53 percent of the total acres (Table 5.9).

TABLE 5.9 - PRIVATE OWNERS OF COMMERCIAL FOREST-LAND AND ACRES OWNED[1/]

SIZE CLASS (Acres)	NUMBER OF OWNERS (Percent)	ACRES OWNED (Percent)
1- 9	70	18
10- 19	11	10
20- 49	13	25
50- 99	4	17
100-199	1	11
200-499	1	10
500+	less than 0.5	9

1/ Derived from unpublished data on forestland ownership in Massachusetts, Northeastern Forest Experiment Station, Upper Darby, Pennsylvania.

Most commercial forest landowners in Massachusetts do not own land for strictly forest product production purposes. A study by Kingsley[10/] of commercial forest landowners in Massachusetts shows that 73 percent of the owners own forestland for land investment, recreation, or view land as part of their residence. These groups own 66 percent of the commercial forestland (Table 5.10).

TABLE 5.10 - REASONS FOR OWNING FORESTLAND

REASON	PERCENT OF OWNERS	PERCENT OF ACREAGE
Land investment	16	19
Recreation	16	21
Timber production	4	10
General farm use	9	12
Part of the residence	41	26
Other	14	12
TOTAL	100	100

Kingsley estimated that 56 percent of the privately-owned commercial forestland in Southern New England (Massachusetts, Connecticut, and Rhode Island) is available for the cutting of wood products.

Based on this percentage, 508,000 acres of forestland in the Coastal Region are available for the cutting of wood products. The acreage available does not take into account such necessary factors as timber quality, site conditions, logging conditions, or the economics of logging.

5.3 INLAND FLOODING

The Massachusetts Water Resources Study has focused its emphasis in the area of flooding on inland flooding only. Although damage from tidal flooding in the region is severe, there are no viable options available through USDA programs to reduce the damage. In fact, in most of the region, there are no alternatives to reduce tidal damage except the relocation of flood prone development. The National Flood Insurance Program, with its restriction on development of flood prone areas, will do much to limit future increases in coastal flood damage, but the existing damageable property will remain at peril.

The Massachusetts Office of Coastal Zone Management is involved in the development of data to assess tidal flooding hazards and to develop policies for limiting property damage from such events. Programs of the New England Division of the Army Corps of Engineers have been utilized to reduce major urban tidal flooding in the region. The Charles River Dam in Boston and the New Bedford Hurricane Barrier are perhaps the best known of the Corps' projects.

Major inland floods in the region have been the result of hurricane rains dumping great volumes of water over a two- or three-day period, or late winter storms causing rain to fall on frozen ground, or snow, resulting in relatively large runoff volume. The most recent hurricane which caused

large scale inland flooding was hurricane Diane in August of 1955. Rainfall from the storm exceeded 15 inches, with nearly 12 inches concentrated in one 24-hour period. In the Neponset and Mystic River Basins, the Diane hurricane flood remains the largest recorded flow. For the other basins in the region, however, the storm of March 17-19, 1968 produced the record flood discharges. According to the U.S. Geological Survey, "The Flood of March 18-20 was outstanding. Many streams with long-term streamflow records experienced flood peaks that exceeded previous maximums. For the Ipswich River, the March maximum flow was the greatest since at least 1886, the year of another great winter flood. At Charles River Village on the Charles River, the peaks equaled that of August 1955, both of which were greater than any other since at least 1886. Many streams reached peaks with recurrence intervals greater than 50 years. Streams such as the Wading and Taunton Rivers in southeastern Massachusetts had peak flows of this magnitude."[11]

The March 1968 storm produced from two to seven inches of rainfall in the region (See Figure 5.8).

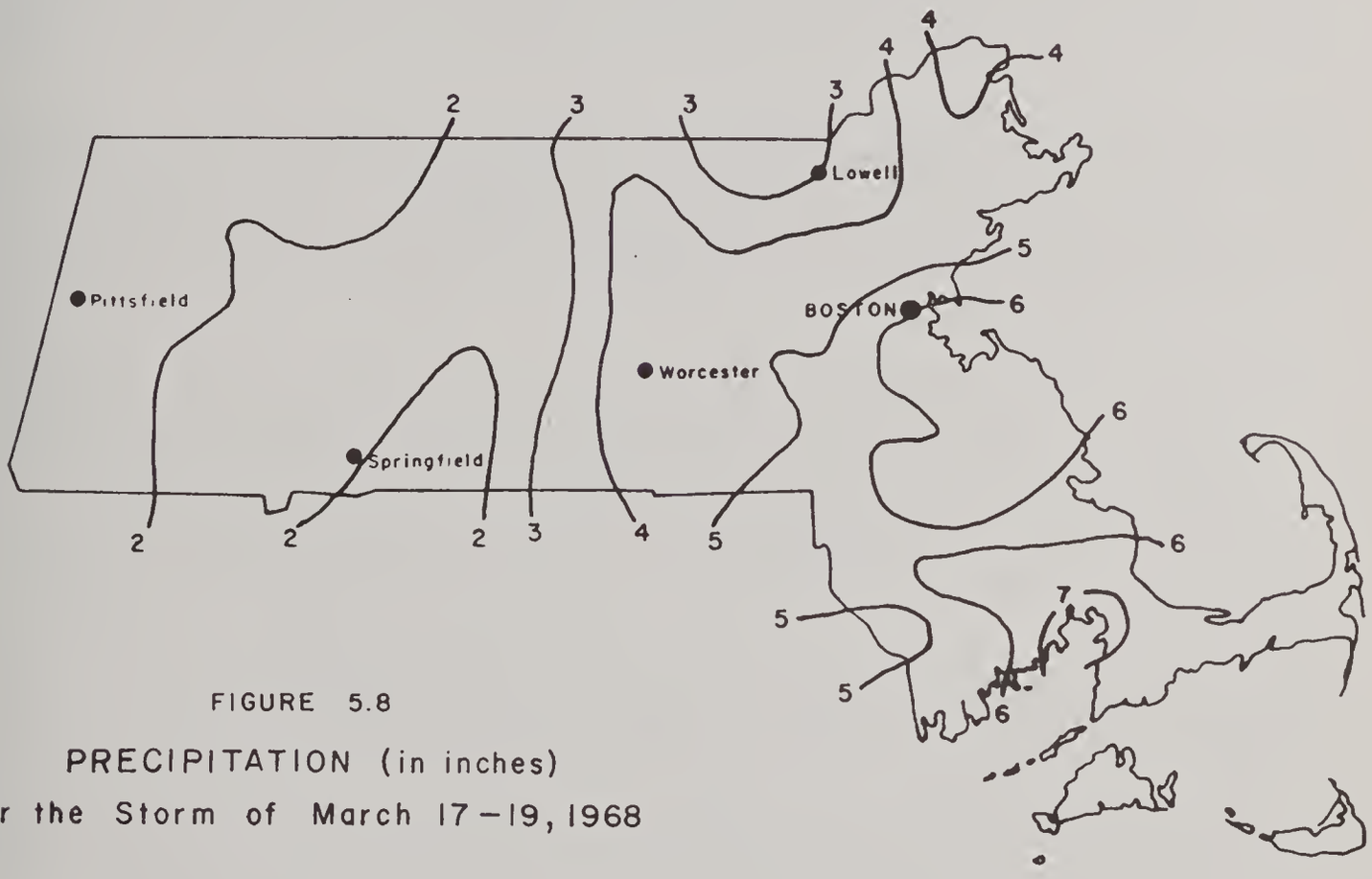


FIGURE 5.8

PRECIPITATION (in inches)
for the Storm of March 17-19, 1968

A large part of the snow cover in the region had melted prior to the storm of March 17-19. Wetlands were already saturated and streamflows were above normal. When the rains fell on frozen ground, the resulting floods were inevitable.

The flood of March 1968 caused damage to a number of properties which had been developed in the late 1950s and early 1960s. Many of the property owners did not consider themselves to be in a flood prone area. The "1968 Post Flood Report for Flood of 18-25, March 1968 in New England"[12/] summed the problem as follows: "Many of the developments are some distance from major streams and the threat of flooding was not apparent. Moreover, the first half of the 1960 decade was a time of drought in the northeast, and this tended to mask the problem as ground water levels were at record lows during the period. With the return to normal levels in 1967, the area needed only a major storm with rapid runnoff to be in real trouble."

As urbanization and suburbanization extended outward from the Boston metropolitan area, pressure to fill in and develop wetland areas proceeded at a rapid pace. The development of wetlands was especially rampant in Norfolk County and decreased as the distance from Boston increased. From 1951 to 1971, the Massachusetts Map Down figures[13/] indicate that the shallow freshwater wetland area in Norfolk County decreased from 10,200 acres to only 5,800 acres. Although the loss was not as severe in other counties of the region, the same pattern of filling is apparent.

The filling of wetlands for development not only endangered the developed area itself, but compounded problems downstream. As a wetland was filled, its ability to reduce flood peaks by storing water for later release was diminished. In addition, the conversion of marshland and vegetation to rooftops and paved parking lots resulted in an increased volume of runoff for an equal amount of rainfall.

Historically, many industries were located on the flood plain, because water was used for power. The alternative of developing in the uplands was more costly, since it meant substituting a more expensive energy source, if water was needed for power; or transporting plant wastes a greater distance, if water was needed as a discharge medium. Roads were developed on flood plains because of lower installation costs--it was less expensive to build on the flat valley lands than to route highways over upland terrain. Residential building was the result of lower site development costs associated with flood plain lands. In addition, much residential development was stimulated by the existing industrial flood plain development; i.e., housing for factory workers was often located on the same flood plain as the factory, for convenience.

In flood plain development, one significant cost determinant was often excluded from the decision-making process--this being the cost of flood damage. In some instances, the flood hazard was not recognized or not present in the same severity at the time of construction. In other cases, the hazard was recognized, but the severity was misjudged. In still other cases, federal disaster assistance after the flood encouraged rehabilitation of flood damaged property in the same location.

Field investigations made by the Soil Conservation Service indicate that average annual, inland flood damage in the region exceeds $2,400,000, and that a 100-year frequency flood would cause damage in excess of $21 million. Average annual damages and damage expected from a 100-year flood in each of the region's subwatersheds are summarized in Table 5.11 and Figure 5.9.

5.4 EROSION AND SEDIMENT

Soil erosion results from the action of moving water, wind, gravity, frost, or a combination of these forces on the land. The main concerns in the region are water-activated erosion and its by-product--sedimentation. In addition, natural or geologic erosion should be differentiated from accelerated erosion.

> "Natural or geologic erosion is a continuing process and will go on into the future regardless of anything man can do. Quickening of the pace of erosion, owing to changes wrought by man, has produced definitely abnormal conditions. Accelerated erosion, an abnormal and undesirable process, was started by man's activities and is subject to his control."[14/]

Sheet, rill, gully, stream and roadbank erosion occur in the region; but, in general, the erosion rate is low in comparison to the southern or western portions of the United States.

Erosion is not only a problem in itself, but also serves as a source for sediment. When erosion occurs, the eroded material will usually create a second problem when deposited in stream channels, reservoirs, lakes, wetlands, and rivers. Along with the individual soil particles which constitute sediment, any fertilizer, pesticides, animal waste, or other organic matter attached to or adjacent to the soil particles is also carried off. The net result is possible impairment of stream water quality.

Erosion and sediment problems have historically been corrected with land treatment measures which are the application of a combination of practices that will meet specific objectives. These objectives include controlling soil erosion, decreasing runoff of rainfall, improving soil and plant productivity, improving wildlife habitat, and improving environmental quality. The practices are classified as management, vegetative and cultural, or mechanical.

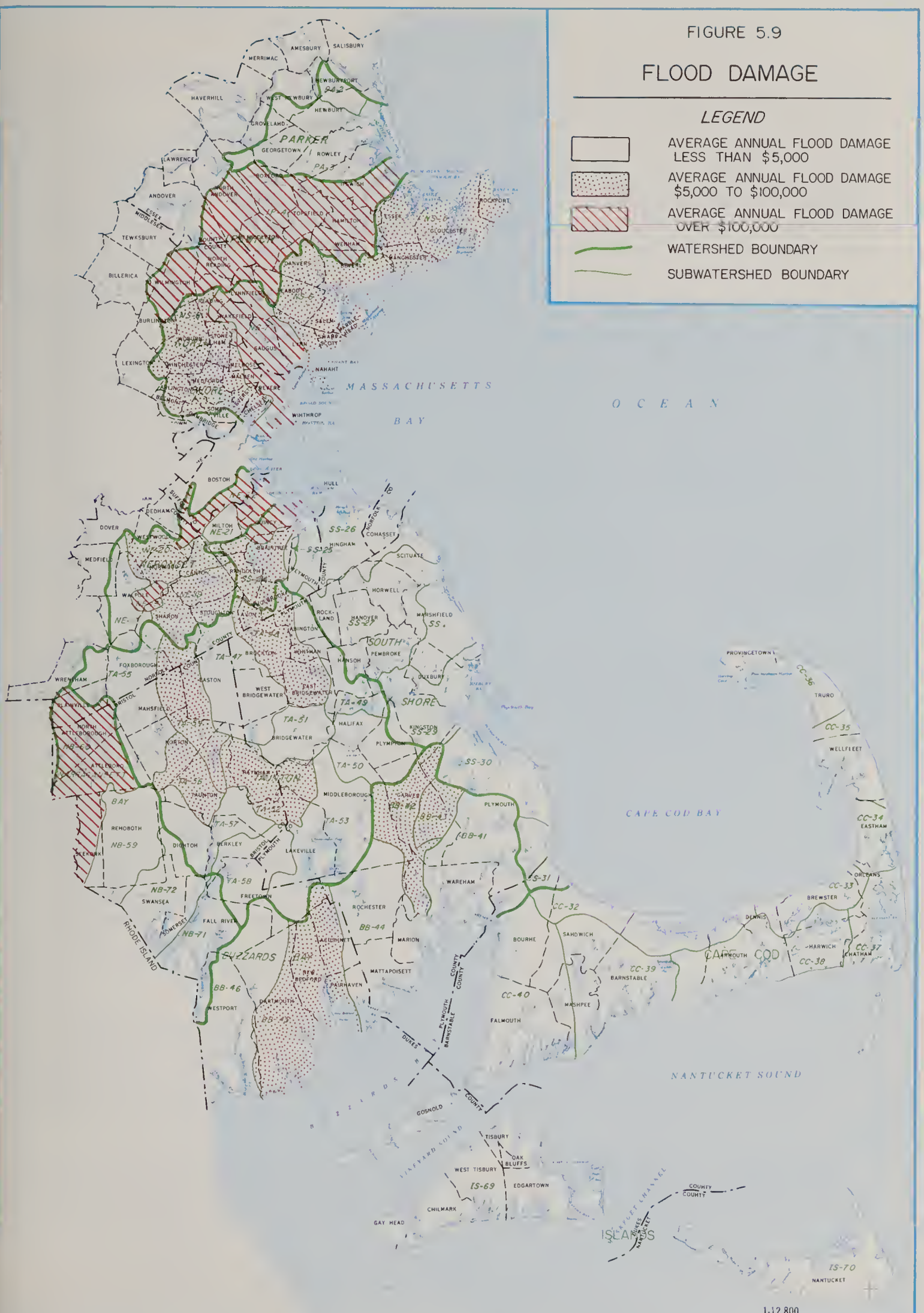
Mechanical practices include diversions, terraces, waterways, outlets and small grade stabilization structures. These practices are designed to reduce erosion by reducing the length of slope and by providing proper courses for transporting the water at nonerosive velocities. When used with vegetative practices, mechanical practices can be extremely effective in reducing erosion.

Examples of vegetative and cultural practices are: conservation cropping systems, cover cropping, contour strip cropping, and planting of grasses, legumes, shrubs, and trees on critical areas. These practices protect the

TABLE 5.11 - PRESENT FLOOD DAMAGES[1/]

Subwatershed	100-Year Flood Damage	Average Annual Damage
	-Parker River Watershed-	
PA-2 (Little River)		2/
PA-3 (Parker River)		2/
	-Ipswich River Watershed-	
IP-4 (Ipswich River)	2,020,000	121,200
	-North Shore Watersheds-	
NS-5 (Annisquam River)	115,800	20,900
NS-6 (Danvers River)	517,800	93,100
NS-7 (Saugus River)	1,635,000	179,800
NS-8 (Mystic River)	108,000	19,400
	-Neponset River Watershed-	
NE-17 (Neponset River)		2/
NE-18 (Diamond-Traphole Brooks)	1,379,000	169,100
NE-19 (Neponset River)	73,000	8,100
NE-20 (Neponset River)	600,000	36,000
NE-21 (Pine Tree Brook)		2/
NE-22 (Neponset River)	5,675,000	624,200
	-South Shore Watersheds-	
SS-23 (Town River)	4,385,000	482,500
SS-24 (Monatiquot River)	355,200	21,400
SS-25 (Smelt Brook)		2/
SS-26 (Weir River)		2/
SS-27 (North River)		2/
SS-28 (South River)		2/
SS-29 (Jones River)		2/
SS-30 (Eel River)		2/
SS-31 (Cape Cod Canal)		2/
	-Taunton River Watershed-	
TA-47 (Town River)		2/
TA-48 (Matfield River)	437,400	26,300
TA-49 (Shumatuscacant River)		2/
TA-50 (Winnetuxet River)		2/
TA-51 (Taunton River)		2/
TA-52 (Taunton River)	182,400	10,900
TA-53 (Nemasket River)		2/
TA-54 (Mill River)	122,600	7,300
TA-55 (Rumford River)		2/
TA-56 (Threemile River)	835,800	50,200
TA-57 (Taunton River)		2/
TA-58 (Assonet River)		2/
	-Narragansett Bay Watersheds-	
NB-59 (Palmer River)		2/
NB-60 (Ten Mile River)	2,049,600	367,900
NB-71 (Quequechan River)		2/
NB-72 (Cole River)		2/
	-Buzzards Bay Watersheds-	
BB-41 (Agawam River)		2/
BB-42 (Weweantic River)	488,000	88,000
BB-43 (Crane Brook)		3/
BB-44 (Mattapoisett River)		2/
BB-45 (Acushnet River)	211,800	38,200
BB-46 (Westport River)		2/
	-Cape Cod & Islands-	
All Cape Cod and Islands subwatersheds have less than $5,000 in average annual damage.		

1/ Price Base 1976.
2/ Average Annual Damage less than $5,000.
3/ Crane Brook damage figures have been included with those for Weweantic River.


FIGURE 5.9
FLOOD DAMAGE
LEGEND
AVERAGE ANNUAL FLOOD DAMAGE LESS THAN $5,000
AVERAGE ANNUAL FLOOD DAMAGE $5,000 TO $100,000
AVERAGE ANNUAL FLOOD DAMAGE OVER $100,000
WATERSHED BOUNDARY
SUBWATERSHED BOUNDARY
MASSACHUSETTS BAY
OCEAN
CAPE COD BAY
NANTUCKET SOUND
BUZZARDS BAY
RHODE ISLAND
ISLANDS
PARKER
NORTH COASTAL
NORTH
METROPOLITAN
SOUTH SHORE
TAUNTON
NEPONSET
NE-
SOUTH
SHORE
CAPE COD
NS-61
NS-6
NE-21
NE-26
SS-26
SS-25
SS-27
SS-29
SS-30
SS-31
TA-47
TA-49
TA-51
TA-50
TA-53
TA-55
TA-56
TA-57
TA-58
TA-42
NB-62
NB-59
NB-72
NB-71
BB-41
BB-42
BB-43
BB-44
BB-46
CC-32
CC-33
CC-34
CC-35
CC-36
CC-37
CC-38
CC-39
CC-40
IS-69
IS-70
1-12,800

soil from the impact of raindrops, reduce runoff, and reduce the contact between soil particles and flowing water.

Minimum tillage, forest watershed management, timber stand improvement, timely field operations, proper grazing use, recreation and wildlife area management, and maintenance operations are all examples of management practices. These practices minimize the overuse of the land while, at the same time, improve the condition of the cover.

For forestland, land management and treatment measures can be applied through cooperative federal, state, and local efforts. One objective is to protect and improve watershed conditions that will control surface runoff, thereby reducing excessive erosion and sedimentation. Effective measures include forest fire protection, planting vegetation on exposed soils, skid trail and logging road stabilization, and leaving tree buffer strips by streambanks.

Winter logging should be encouraged, where protection of other land values is critical, since disturbance to the forest floor is less likely to occur during this time of year when the soil is frozen.

As mentioned, land treatment is planned for other objectives besides erosion control, but adequate protection of the soil is of primary importance. Land treatment has been found to be as effective in urban applications as it is in the rural sector.

In addition to land treatment, land use planning and structural measures are also applied to minimize erosion. Land use planning can be developed to guide the use, growth and development of land in the cities and towns. Land subject to excessive erosion can be converted to other land uses which have a lower erosion rate. Areas such as flood plains and steep slopes can be managed to reduce erosion and sediment damage.

Structural measures can be designed and used to protect the land from erosion and sediment. Some of the appropriate measures are debris basins, riprapping, channel improvements, and grade stabilization structures. Erosion and sedimentation can be reduced by decreasing high stream flows with flood control measures. Impoundments and natural storage basins will also collect the sediment in the stream and reduce sediment deposits downstream. The water quality in the stream should also be improved by reducing sediment loads.

A. Erosion

To assess the extent of erosion and sediment problems in the Coastal Region, the land area was divided into three types based on general susceptibility to erosion. These "Erosion Land Types" were: 1. upland; 2. terrace; and 3. flood plain. Location and extent of the types are shown on Figure 5.10.

Based on the judgement of Soil Conservation Service field technicians, the following types of areas were thought to represent the major erosion potential: farmland in cultivation, forestland being harvested, road-

FIGURE 5.10

EROSION LAND TYPE MAP

LEGEND

FLOOD PLAIN TYPE

TERRACE TYPE

UPLAND TYPE



1-12,801

banks, unpaved roads, gravel pits, construction areas, streambanks, utility rights-of-way, and sand dunes.

Sand dunes with insufficient vegetative cover or which are situated in areas subject to storm erosion were identified as problems in the Coastal Region, especially on the South Shore and Cape Cod. Another related problem is the loss of coastal shoreline, due to the inherent dynamics of material redistribution along the New England coast. Some areas are continually losing material which is transported by currents to other areas of shoreline which are being built-up.

The Massachusetts Office of Coastal Zone Management has completed a series of citizen-initiated maps which inventory and assess coastal erosion areas. The New England Division of the Army Corps of Engineers has also prepared a number of publications assessing coastal erosion problems in specific areas along the Massachusetts coast.

Those erosion problems which are directly related to the forces of the ocean were considered to be instances where little assistance could be provided in the way of alternatives to reduce the problem. Expensive structural measures are usually required to control wave-induced erosion. In many cases, coastal erosion control in one area results in aggravation of erosion in adjacent areas which are "starved" for sand to replace eroded material. Thus, the construction of a groin or bulkhead to solve a local erosion problem may be the start of a series of construction efforts, as the erosion problem is shifted. Likewise, the erosion of many sand dunes is accelerated by wave action undermining the toe of the dune, causing slipping of material, and loss of vegetation. Minimizing the erosion of the dune often requires structural measures to protect the toe of the dune from wave action with many of the same consequences as described for other structural measures in wave areas. For these reasons, the problem of erosion due to the forces of the ocean was deemed beyond the scope of this study. In the majority of cases, the "solution" to this erosion problem rests with proper land use that recognizes the dynamic nature of the land-water interface.

Sand dunes which are not affected by the ocean waves have a better chance of being stabilized by tried and proven methods. Well-vegetated dunes tend to resist erosion. Only when the vegetation is killed by foot or vehicle traffic is the dune likely to be susceptible to wind erosion. Many of the sand dunes in the Coastal Region are in a constant state of flux. Foot paths or motor bike trails serve as a source for wind-blown sand. Nearby vegetation traps the blowing sand resulting in a new dune configuration. If traffic is controlled, vegetation eventually moves in to heal the eroded area. The healing process can be hastened by planting new vegetation on eroding areas. The Massachusetts Department of Environmental Management has established a nursery in Myles Standish State Forest to provide municipalities with a source for beachgrass to revegetate eroding dunes. Landowners can obtain beachgrass stock from commercial sources. Many coastal communities are utilizing vegetation, sand fence, and discarded Christmas trees to control wind erosion on sand dunes. In

many cases, these low cost measures, when combined with restrictions on foot and vehicular traffic, are quite effective in reducing or controlling wind erosion.

Other potential erosion problem areas were studied, using a sampling basis to determine the extent of the erosion. Samples were made in each of the three "Erosion Land Type" areas. Soil Conservation Service technicians visited known problem farms to quantify the erosion. Gravel pits and construction areas were also selected, based on known problems, or areas which appeared to have potential problems. Forestland erosion rates were estimated by Forest Service personnel. Erosion from roadbanks, unpaved roads, streambanks, and utility rights-of-way was estimated by inventorying the problems noted along a specified length of sample reach.

These erosion samples and case studies formed the basis for calculating erosion rates for the various problem types in each Erosion Land Type. The MacConnell's Massachusetts Map Down series was used to determine the number of acres in various land uses in each Erosion Land Type.

Adjustments were made to account for sampling methods and different cropping patterns to arrive at the average rates presented in Table 5.12.

Because of the great variability of coastal erosion rates, no attempt was made to calculate the erosion volume from this source. Losses of shoreline can range from nothing to more than 10 feet per year. Some parts of the shore are experiencing accretion of material which was eroded from another portion of the coastline. Differences are primarily a function of the shoreline material, prevailing currents, predominant wind direction, and degree of shelter from storms.

Two of the areas originally thought to be serious erosion problems were found, upon field examination, to be rather minor.

Gravel pits and earth removal operations, with their disruption of vegetation and steep side slopes, were felt to be potential erosion and sediment problems. Examination showed that, although erosion of side slopes was indeed a severe problem in terms of the volume of soil being moved, little or no material left the actual gravel pit, thus eliminating the sediment problem off-site. It seems that what appeared to be a major source of sediment was not a problem beyond the limits of the removal operation and is probably not even a "problem" to the pit operator.

Nearly 80 percent of the communities in the region have bylaws which regulate gravel pits and earth removal activities. These communities are shown on Figure 5.11. The bylaws and regulations are designed to limit the off-site effects of earth removal activities and seem quite successful in accomplishing their intended purpose.

The most noticeable off-site erosion problem from gravel pits is an aesthetic or visual quality deterioration which results when wind storms erode fine-grained material. The material is often carried from the pit

TABLE 5.12 COASTAL REGION EROSION DATA

Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
Coastal Region			
1. Tilled Cropland	13,874	4.3	60,390
2. Other Agricultural Land	93,372	0.2	17,630
a. Orchards, bushfruit, nurseries	2,726	0.2	(620)
b. Cranberry bogs	19,537	0	(0)
c. Pasture, hayland, unused tilled	71,109	0.2	(17,012)
3. Abandoned orchards, abandoned fields, power line rights-of-way	83,782	0.3	21,560
4. Forest	779,046	0.1	83,400
5. Wetlands, wooded swamps (nonsediment producing)	199,282	0.	0
6. Urban	401,092	0.3	121,250
7. Construction sites (annual)	9,448	36.	340.130
Land Erosion - Total	1,579,896	0.4	644,360
8. Streambanks susceptible to erosion	(miles)	(tons/mile)	
Major Streams	103	66	6,831
Tributaries	208	166	34,487
Total Erosion			685,678
Barnstable County			
1. Tilled Cropland	207	4.1	840
2. Other Agricultural Land	6,539	0.2	1,220
a. Orchards, bushfruit, nurseries	174	0.3	50
b. Cranberry bogs	2,526	0	0
c. Pasture, hayland, unused tilled	3,832	0.3	1,170
3. Abandoned orchards, abandoned fields, power line rights-of-way	16,015	0.3	4,810
4. Forest	150,314	0.1	15,030
5. Wetlands, wooded swamps (nonsediment producing)	21,836	0	0
6. Urban	56,580	0.3	16,970
7. Construction sites (annual)	1,874	36.	67,460
Land Erosion - Total	253,355	0.4	106,330
Bristol County			
1. Tilled Cropland	7,040	4.4	30,730
2. Other Agricultural Land	31,930	0.2	6,409
a. Orchards, bushfruit, nurseries	618	0.2	120
b. Cranberry bogs	818	0	0
c. Pasture, hayland, unused tilled	30,494	0.2	6,285
3. Abandoned orchards, abandoned fields, power line rights-of-way	17,164	0.2	3,430
4. Forest	168,086	0.1	16,809
5. Wetlands, wooded swamps (nonsediment producing)	50,713	0	0
6. Urban	73,966	0.3	22,190
7. Construction sites (annual)	1,583	36.	56,990
Land Erosion - Total	350,482	0.5	136,560

TABLE 5.12 COASTAL REGION EROSION DATA

Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
Dukes County			
1. Tilled Cropland	75	4.0	300
2. Other Agricultural Land	2,678	0.3	810
a. Orchards, bushfruit, nurseries	7	0.3	2
b. Cranberry bogs	7	0	
c. Pasture, hayland, unused tilled	2,664	0.3	803
3. Abandoned orchards, abandoned fields, power line rights-of-way	7,238	0.3	2,170
4. Forest	47,708	0.1	4,770
5. Wetlands, wooded swamps (nonsediment producing)	2,146	0	0
6. Urban	5,039	0.4	2,020
7. Construction sites (annual)	167	36.	6,010
Land Erosion - Total	65,051	0.3	16,080
Essex County			
1. Tilled Cropland	1,737	4.1	7,210
2. Other Agricultural Land	14,117	0.2	2,940
a. Orchards, bushfruit, nurseries	802	0.2	160
b. Cranberry bogs	0	0	0
c. Pasture, hayland, unused tilled	13,315	0.2	2,780
3. Abandoned orchards, abandoned fields, power line rights-of-way	9,526	0.2	1,910
4. Forest	94,288	0.15	14,143
5. Wetlands, wooded swamps (nonsediment producing)	40,524	0	0
6. Urban	61,444	0.3	18,430
7. Construction sites (annual)	1,449	36.	52,160
Land Erosion - Total	223,085	0.4	96,790
Middlesex County			
1. Tilled Cropland	105	4.5	470
2. Other Agricultural Land	719	0.2	150
a. Orchards, bushfruit, nurseries	251	0.2	50
b. Cranberry bogs	11	0	0
c. Pasture, hayland, unused tilled	457	0.2	104
3. Abandoned orchards, abandoned fields, power line rights-of-way	1,921	0.2	380
4. Forest	15,640	0.15	2,350
5. Wetlands, wooded swamps (nonsediment producing)	8,147	0	0
6. Urban	32,941	0.3	9,880
7. Construction sites (annual)	516	36.	18,580
Land Erosion - Total	59,989	0.5	31,810

TABLE 5.12 COASTAL REGION EROSION DATA

	Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
	Nantucket County			
1.	Tilled Cropland	88	3.9	340
2.	Other Agricultural Land	1,099	0.2	228
	a. Orchards, bushfruit, nurseries	0	-	0
	b. Cranberry bogs	349	0	0
	c. Pasture, hayland, unused tilled	750	0.3	228
3.	Abandoned orchards, abandoned fields, power line rights-of-way	11,543	0.3	3,460
4.	Forest	11,023	0.1	1,100
5.	Wetlands, wooded swamps (nonsediment producing)	2,263	0	0
6.	Urban	4,152	0.4	1,660
7.	Construction sites (annual)	150	36.	5,400
	Land Erosion - Total	30,318	0.4	12,190
	Norfolk County			
1.	Tilled Cropland	290	3.9	1,150
2.	Other Agricultural Land	3,805	0.2	860
	a. Orchards, bushfruit, nurseries	239	0.2	50
	b. Cranberry bogs	36	0	0
	c. Pasture, hayland, unused tilled	3,530	0.2	810
3.	Abandoned orchards, abandoned fields, power line rights-of-way	6,026	0.2	1,210
4.	Forest	61,144	0.1	6,114
5.	Wetlands, wooded swamps (nonsediment producing)	15,700	0	0
6.	Urban	53,975	0.3	16,190
7.	Construction sites (annual)	1,111	36.	40,000
	Land Erosion - Total	142,051	0.5	65,510
	Plymouth County			
1.	Tilled Cropland	4,332	4.5	19,350
2.	Other Agricultural Land	32,333	0.1	4,980
	a. Orchards, bushfruit, nurseries	585	0.3	180
	b. Cranberry bogs	15,790	0	0
	c. Pasture, hayland, unused tilled	15,958	0.3	4,810
3.	Abandoned orchards, abandoned fields, power line rights-of-way	13,245	0.3	3,970
4.	Forest	228,697	0.1	22,870
5.	Wetlands, wooded swamps (nonsediment producing)	56,523	0	0
6.	Urban	81,602	0.3	24,480
7.	Construction sites (annual)	2,565	36.	92,340
	Land Erosion - Total	419,297	0.4	167,990

TABLE 5.12 COASTAL REGION EROSION DATA

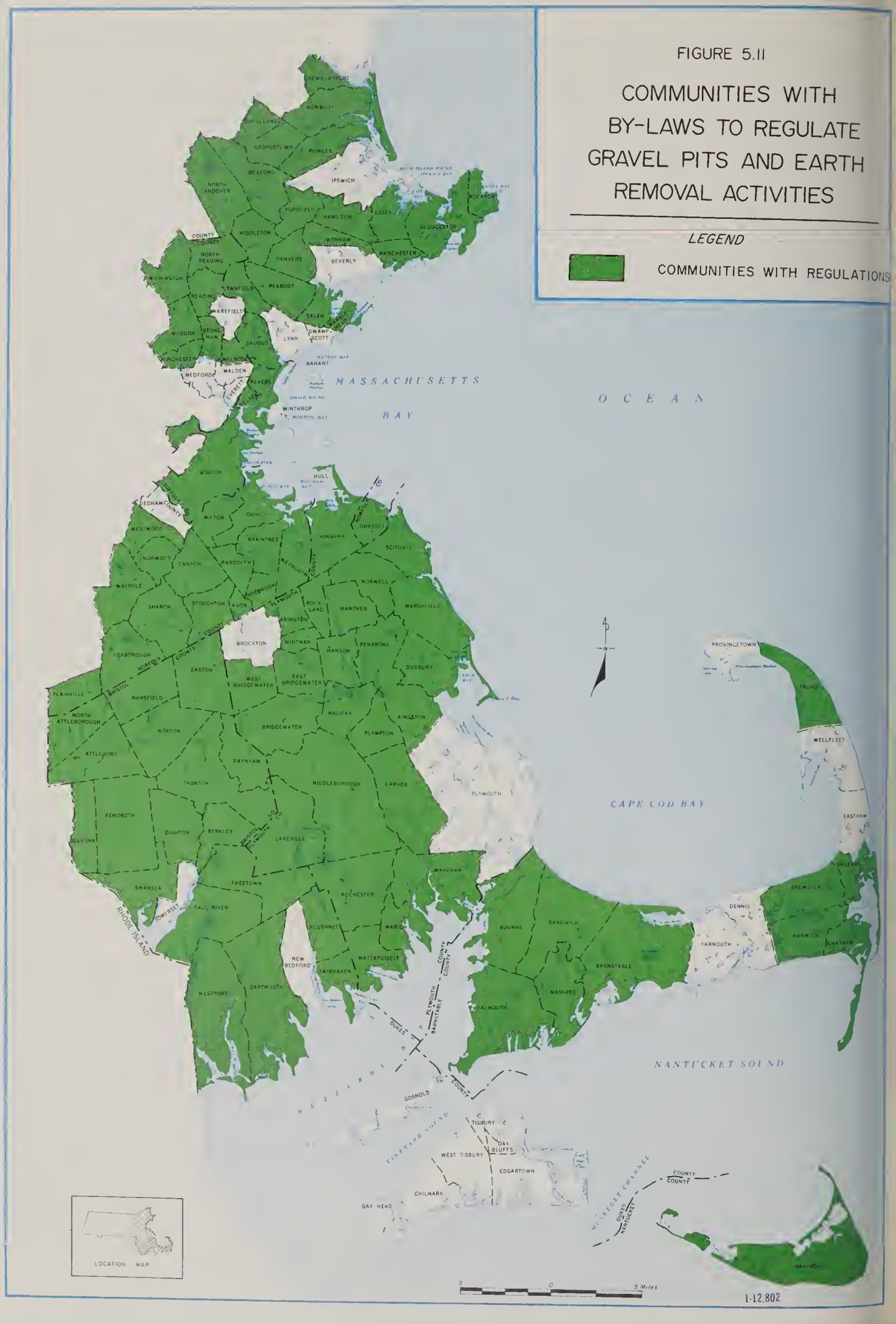
	Land Use	Area (acres)	Annual Erosion Rate (tons/acres)	Annual Erosion (tons)
		Suffolk County		
1.	Tilled Cropland	0	-	0
2.	Other Agricultural Land	159	0.2	30
	a. Orchards, bushfruit, nurseries	50	0.2	10
	b. Cranberry bogs	0	0	0
	c. Pasture, hayland, unused tilled	109	0.2	22
3.	Abandoned orchards, abandoned fields, power line rights-of-way	1,104	0.2	220
4.	Forest	2,146	0.1	210
5.	Wetlands, wooded swamps (nonsediment producing)	1,430	0	0
6.	Urban	31,396	0.3	9,420
7.	Construction sites (annual)	33	36.	1,190
	Land Erosion - Total	36,268	0.3	11,070

FIGURE 5.11

COMMUNITIES WITH BY-LAWS TO REGULATE GRAVEL PITS AND EARTH REMOVAL ACTIVITIES

LEGEND

COMMUNITIES WITH REGULATIONS



1-12,802

area and creates a nuisance situation for nearby residents. The problem is usually localized in the vicinity of the gravel pit area.

Another potential problem concern was removed after the field sampling program. Erosion along roadways was an erosion area often mentioned in discussions with local leaders and Soil Conservation Service personnel. Sampling of more than 100 miles of roadway resulted in the collection of a stack of sampling forms with the notation "No Problem." In the few cases where problems were noted and quantified, the field observer estimated the eroded volume in the 5-10 cubic yard range. When this volume was adjusted for the length of sample reach and further reduced by computing an annual rate of erosion, the small numbers were insignificant. This is not to say that severe isolated cases of roadbank erosion do not exist, but when found, they represent a small percentage of the total roadbank mileage.

Although total gross erosion from urban and "other" land areas is high (121,000 tons per year), the rate of erosion is quite low (0.3 ton per acre). The basic reason for the high total erosion is the large area in urban and "other" land use (400,000 acres). The erosion rate for urban land is considered to be acceptably low, and no further action is needed to reduce the rate.

The areas with the highest erosion rates were found to be urbanizing areas which were under construction. The average erosion rate for construction sites was estimated to be 36 tons per acre. This figure varies enormously depending on such factors as site topography, slope, construction practices, and time of year, but the 36-tons per acre represent a good average value for the region. Construction areas have the highest rates of erosion since, by their very nature, they involve the removal of protective vegetation and exposure of bare soil to the eroding effects of wind and, more importantly, water.

Good erosion control practices during construction can do much to reduce erosion problems, and reduce the rate of erosion. The Soil Conservation Service has prepared a publication entitled "Guidelines for Soil and Water Conservation in Urbanizing Areas of Massachusetts"[15/] which details some of the construction practices. Erosion control measures during construction add minimally to the total construction cost; however, many contractors and owners are reluctant to spend money for "nonconstruction" type measures. To control erosion during construction, a small number of communities have adopted sediment and erosion control bylaws.

Erosion losses from tilled cropland represent the second highest erosion volume in the region. The average erosion rate of 4.3 tons per acre exceeds the average allowable erosion rate of 3 tons per acre by over 40 percent. Topsoil is a valuable natural resource containing most of the soil organic matter and the nutrients required by plants for crop production. Soil scientists estimate that to maintain productivity over time, annual soil losses on most Massachusetts' agricultural soils must be limited to no more than 3 tons per acre.

The average erosion rate for tilled cropland in the Coastal Region of 4.3 tons per acre is not extremely excessive. There are, however, individual farms which have critical erosion problems and extremely high rates of erosion loss. Bristol and Plymouth Counties account for approximately 80 percent of the tilled cropland erosion in the region.

As noted in Table 5.8, a relatively high percentage of the farming in the Coastal Region is taking place on soils other than prime farmland soils, or soils of state and local importance for farming. These "other" soils which are being farmed often have serious erosion problems resulting from steep slopes or the naturally high erodibility of soil type.

Establishment and maintenance of good conservation practices by the majority of the region's farm operators have done much to reduce total erosion from farmland. However, more needs to be done by the minority of farmers who have severe erosion problems on their land.

Sampling and surveys have shown that erosion from wetlands, cranberry bogs, pasture, forest, orchards, abandoned fields, and established urban areas is not a serious problem.

Streambank erosion is a relatively minor problem, as compared to that experienced in the other parts of Massachusetts. The relatively low stream gradients and slow moving streams are the main reason for the low streambank erosion.

Since sampling showed that Bristol and Plymouth Counties accounted for over half of the total land erosion in the region, an inventory of critical erosion areas was made for these counties and Barnstable County. Results of the inventory are presented in Table 5.13.

B. Sediment

If the entire volume of erosion in the region were to result in sediment which was delivered to streams and rivers, the results would be catastrophic. Fortunately, a large percentage of the erosion products from land areas are deposited on land before reaching a watercourse. Stone walls, fences, strips of vegetation, forestland, and even flat slopes cause the erosion products to be deposited. Delivery rates of sediment to streams may be 10 percent or less of the original eroded volume.

On the other hand, erosion from streambanks results in a very high percentage of eroded material becoming sediment, which pollutes the stream. Cobbles and boulders usually remain fairly close to their orginal location, sand may settle out in the flat stretches of streams and in pools, but the fine sand and silt fraction remains as suspended sediment to dirty the water and reduce its attractiveness as fish habitat and as habitat for insects in the fish food-chain.

TABLE 5.13 - CRITICAL EROSION AREA INVENTORY

Municipality	Number of Critical Erosion Areas Inventoried					
	Roadbank	Gravel Pits[1/]	Cropland	Urban Development	Other	Total
Bristol County	12	130	43	9	3	197
Acushnet		6	5			11
Attleboro	6	8		1		15
Berkley		10	1	2		13
Dartmouth		12	3			15
Dighton		5	1			6
Easton		5	1			6
Fairhaven		2	1			3
Fall River	1					1
Freetown		17	2			19
Mansfield	2	8	4	2		16
New Bedford		3				3
North Attleborough	1	10	2			13
Norton		5	1	1		7
Raynham		8	1			9
Rehoboth	1		5		2	8
Seekonk	1	5	4			10
Somerset						0
Swansea		2				2
Taunton		9	2	3		14
Westport		15	10		1	26
Barnstable County	10	58	0	11	0	79
Barnstable		6		1		7
Bourne	4	6		4		14
Brewster	3			1		4
Chatham						0
Dennis		6				6
Eastham		3				3
Falmouth		13				13
Harwich	1	5				6
Mashpee				3		3
Orleans						0
Provincetown		1				1
Sandwich	1	6		1		8
Truro		5				5
Wellfleet		4				4
Yarmouth	1	3		1		5
Plymouth County	1	61	38	12		112
Abington						0
Bridgewater		1	4	1		6
Brockton						0
Carver		6	1	1		8
Duxbury		3				3
East Bridgewater		1	1	1		3
Halifax		3	12			15
Hanover		1		2		3
Hanson		1		1		2
Hingham						0
Hull						0
Kingston		3				3
Lakeville		3	2			5
Marion		2				2
Marshfield		2				2
Mattapoisett		5				5
Middleborough		7	6	1		14
Norwell		3				3
Pembroke		4				4
Plymouth		1		4		5
Plympton		1	2	1		4
Rochester		5	2			7
Rockland						0
Scituate			2			2
Wareham	1	9	1			11
West Bridgewater			5			5
Whitman						0

1/ Although gravel pits represent a critical erosion area, they have few off-site effects. Therefore, erosion control measures will serve to improve aesthetics of the area but are not necessary to solve off-site sediment or other common "erosion and sediment" problems.

Suspended sediment measurement stations have been established throughout Massachusetts by the U.S. Geological Survey. These stations are located on major streams and monitor suspended sediment at the USGS stream gage locations. Station locations and pertinent data are indicated on Figure 5.12.

Flow-duration data combined with suspended sediment readings were used to prepare Average Annual Sediment data for each station. Although the data has significant scatter, it does present an envelope of values to quantify the suspended sediment situation. The range of values is between 0.015 ton/acre and 0.155 ton/acre. There appears to be little correlation between the size of drainage area and the amount of suspended sediment per unit area. Factors such as upstream dams which act as traps for some of the larger sized sediments were not included in the calculation.

Based on the analysis of suspended sediment data and estimates of quantities of the larger sized "bedload" sediment, it is estimated that total annual sediment in the rivers and streams of the region is approximately 69,000 tons or about 10 percent of the total erosion in the region.

5.5 WETLANDS

Wetlands are those areas where the water table is at or near the ground surface for much of the year and which are subject to occasional flooding. The soils of the wetlands are usually poorly or very poorly drained, except for seasonally flooded flats. These are usually alluvial or flood plain soils which may have better drainage.

See Table 5.14, Area of Wetlands, for a summary of wetland acreage in the region's municipalities. The wetland figures do not include flood plain lands that are dry most of the year, although these usually-dry portions of flood plains are in the same jurisdictional category as wetlands in Massachusetts' wetland legislation. The approximately 159,500 acres of inland wetlands in the region represents 9.5 percent of the total area. Fresh and saltwater wetlands combined represent 11.9 percent of the region's land area. The range is from zero percent in Chelsea to over 42 percent in Wilmington.

TABLE 5.14 - WETLAND REGIONAL SUMMARY

SUBREGION	Acres of Wetlands					
	Inland Wetlands			Fresh Open Water 1/	Salt Marshes	Total
	Open Wetlands	Wooded Swamps	Total			
Northeast	11,031	33,238	44,269	8,185	15,678	68,132
Southeast	23,062	80,602	103,664	29,685	10,375	143,724
Cape and Islands	8,139	3,441	11,580	14,110	14,665	40,355
TOTAL	42,232	117,281	159,513	51,980	40,718	252,211

1/ Does not include river water areas.

FIGURE 5.12
SEDIMENT ESTIMATES AT SELECTED STREAM GAGES

Stream Gage (USGS Gage No.)	Drainage Area (sq. miles)	Suspended Sediment (tons/sq. mile)	Total Sediment (tons/sq. mile)
Taunton River near Bridgewater, Massachusetts (01108000)	260	37	40
Wood River near Arcadia, Rhode Island (01117800)	35.2	12	14
Merrimack River above Lowell, Massachusetts (01096550)	4,635	53	56
Concord River at Lowell, Massachusetts (01099500)	405	13	16
Assabet River at Maynard, Massachusetts (01097000)	116	7	10
Souhegen River New Hampshire (01094000)	171	21	24

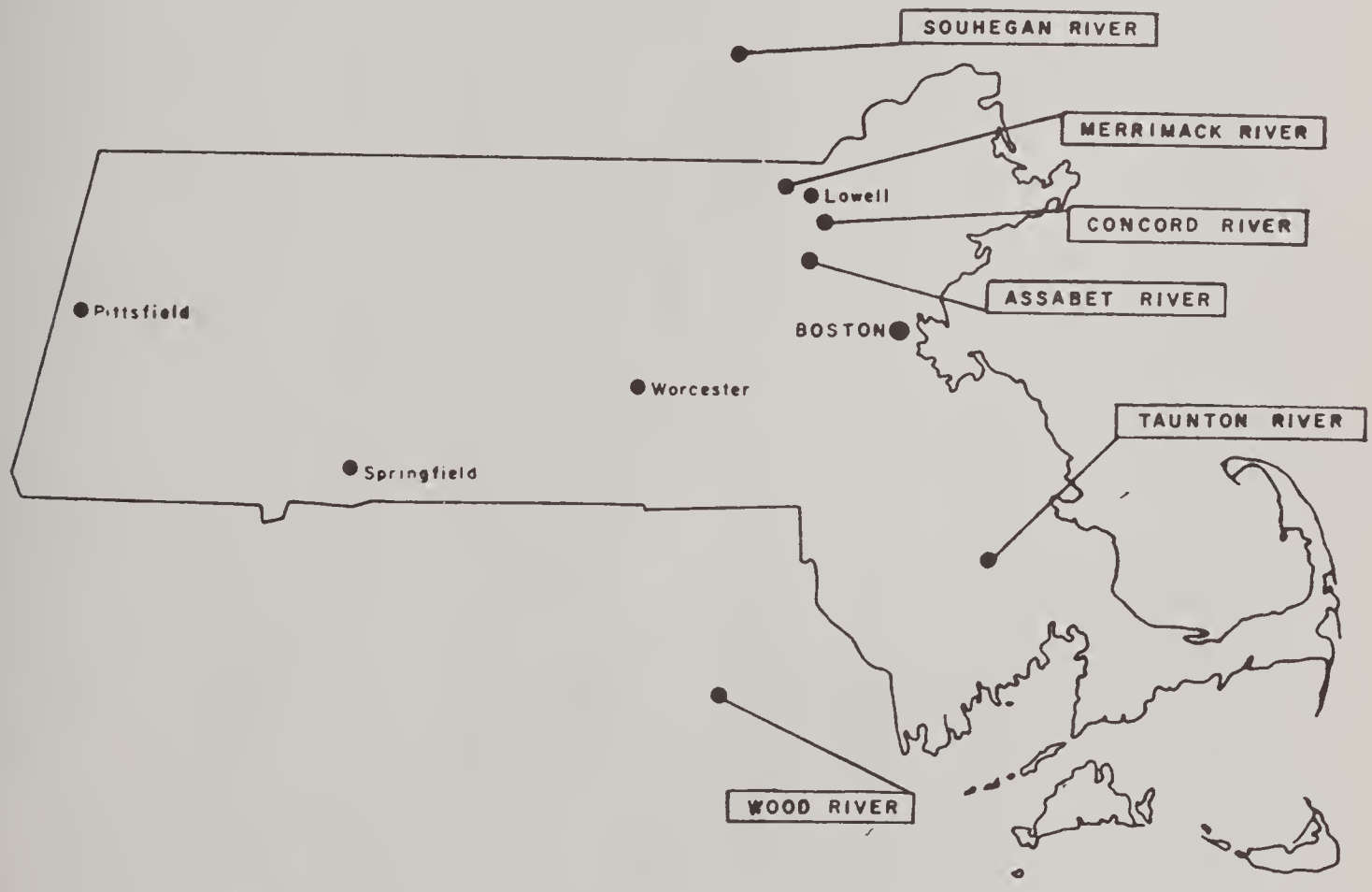


TABLE 5.15

WETLAND AREAS

Municipality	Open Type Wetlands (acres)	Wooded Swamps (acres)	Fresh Open Water (acres)	Total Inland Wetland (acres)	Saltwater Wetlands (acres)	Total Wetlands (acres)	Wetlands as Percent of Municipality
North Shore							
Beverly	138	320	172	630	42	672	6.8
Chelsea	0	0	0	0	0	0	0
Danvers	346	331	389	1066	57	1123	12.9
Essex	439	550	105	1094	1867	2961	31.7
Everett	4	0	0	4	15	19	0.8
Gloucester	213	650	333	1196	878	2074	12.2
Lynn	65	68	311	444	34	478	6.5
Lynnfield	445	1527	212	2184	0	2184	32.2
Malden	0	43	10	53	0	53	1.6
Manchester	89	226	11	326	46	372	7.5
Marblehead	38	20	0	58	11	69	2.4
Medford	19	0	223	242	0	242	4.3
Melrose	7	22	51	80	0	80	2.6
Nahant	12	0	0	12	0	12	1.6
Peabody	345	240	257	842	7	849	7.9
Revere	31	22	82	135	506	641	15.8
Rockport	102	156	78	336	49	385	8.3
Salem	171	52	53	276	40	316	5.3
Saugus	126	196	330	652	685	1337	18.3
Stoneham	55	48	397	500	0	500	11.5
Swampscott	34	5	8	47	0	47	2.4
Wakefield	170	526	341	1037	0	1037	20.3
Winchester	37	28	182	247	0	247	6.1
Winthrop	4	0	14	18	35	53	4.2
Woburn	302	490	173	965	0	965	11.7
Ipswich							
Boxford	316	1830	403	2549	0	2549	16.2
Hamilton	369	2059	254	2682	43	2725	28.5
Ipswich	605	2175	168	2948	4007	6955	30.0
Middleton	457	1285	214	1956	0	1956	21.0
North Andover	428	1737	714	2879	0	2879	16.1
North Reading	427	1080	0	1507	0	1507	17.4
Reading	151	1793	0	1944	0	1944	30.4
Topsfield	757	1065	78	1900	0	1900	23.2
Wenham	202	1196	247	1645	0	1645	30.9
Wilmington	397	2533	96	4671	0	4671	42.2
Neponset							
Boston	247	242	331	820	343	1163	3.7
Canton	634	1545	399	2578	0	2578	20.7
Milton	59	285	66	410	165	575	6.8
Norwood	310	871	18	1199	0	1199	18.1
Sharon	216	2067	517	2800	0	2800	18.1
Walpole	242	1676	270	2188	0	2188	16.4
Westwood	91	745	68	904	0	904	12.7
Parker							
Georgetown	200	1607	113	1920	0	1920	22.8
Groveland	229	694	166	1089	0	1089	17.9
Newbury	662	91	4	757	4592	5349	33.0
Newburyport	408	28	5	441	267	708	10.7
Rowley	432	1114	47	1593	1989	3582	28.1
South Shore							
Braintree	238	446	273	957	15	972	10.7
Cohasset	72	676	167	915	109	1024	16.0
Duxbury	647	692	359	1698	986	2684	17.4
Hanover	310	1115	95	1520	0	1520	15.2
Hingham	254	1705	137	2096	156	2252	15.5
Holbrook	37	655	74	766	0	766	16.1
Hull	4	0	4	8	74	82	4.5
Kingston	399	460	303	1162	140	1302	10.4
Marshfield	726	84	98	908	1977	2885	15.4
Norwell	457	1987	137	2581	140	2721	20.7
Pembroke	583	1581	1235	3399	0	3399	22.2
Plymouth	680	77	4388	5145	238	5383	8.6
Quincy	66	42	81	189	481	670	6.2
Randolph	156	366	316	838	0	838	12.8
Rockland	167	1084	54	1305	0	1305	20.3
Scituate	136	589	168	893	1225	2118	18.8
Weymouth	132	925	513	1570	167	1737	15.1

TABLE 5.15

WETLAND AREAS

Municipality	Open Type Wetlands (acres)	Wooded Swamps (acres)	Fresh Open Water (acres)	Total Inland Wetland (acres)	Saltwater Wetlands (acres)	Total Wetlands (acres)	Wetlands as Percent of Municipality
			Taunton				
Abington	161	506	105	772	0	772	11.9
Avon	37	268	142	447	0	447	14.8
Berkley	292	1402	11	1705	0	1705	15.8
Bridgewater	586	2401	560	3547	0	3547	19.5
Brockton	156	560	87	803	0	803	5.9
Dighton	287	2188	107	2582	0	2582	18.1
East Bridgewater	553	905	192	1650	0	1650	14.8
Easton	501	1390	172	2063	0	2063	11.2
Foxborough	148	507	464	1119	0	1119	8.6
Freetown	677	2974	596	4247	4	4251	18.9
Halifax	818	1756	430	3004	0	3004	27.1
Hanson	845	1333	411	2589	0	2589	26.0
Lakeville	567	1832	3946	6345	0	6345	27.7
Mansfield	227	910	116	1253	0	1253	9.7
Middleborough	1363	6688	1827	9878	0	9878	21.3
Norton	452	2326	688	3466	0	3466	18.7
Plympton	316	1815	108	2239	0	2239	23.2
Raynham	280	1382	164	1826	0	1826	13.9
Stoughton	223	652	76	951	0	951	9.1
Taunton	858	2918	683	4459	0	4459	15.1
West Bridgewater	656	1027	51	1734	0	1734	17.5
Whitman	431	159	7	597	0	597	13.5
			Buzzards Bay				
Acushnet	342	1908	187	2437	40	2477	20.3
Carver	1734	1951	1248	4933	0	4933	17.9
Dartmouth	357	6106	474	6937	1149	8086	20.2
Fairhaven	29	602	19	650	675	1325	16.7
Fall River	329	3202	2824	6355	0	6355	26.0
Marion	147	618	0	765	445	1210	13.3
Mattapoisett	103	835	15	953	498	1451	13.0
New Bedford	149	1834	101	2084	0	2084	16.3
Rochester	815	3123	1551	5489	0	5489	23.8
Wareham	894	370	1031	2295	883	3178	13.4
Westport	264	2557	1288	4109	940	5049	13.6
			Narragansett Bay				
Attleboro	555	2595	426	3576	0	3576	20.0
North Attleborough	156	343	299	798	0	798	6.3
Plainville	191	185	191	567	0	567	7.6
Rehoboth	723	3983	226	4932	0	4932	16.2
Seekonk	365	937	74	1376	0	1376	11.4
Somerset	107	9	163	279	29	308	5.0
Swansea	304	1061	146	1511	4	1515	10.4
			Cape Cod				
Barnstable	611	119	1800	2530	4023	6553	16.0
Bourne	274	43	581	898	311	1209	4.3
Brewster	501	88	1673	2262	247	2509	15.5
Chatham	525	62	260	847	964	1811	11.6
Dennis	509	235	228	972	925	1897	13.4
Eastham	118	56	175	349	1278	1627	16.0
Falmouth	324	87	998	1409	512	1921	6.1
Harwich	724	125	1035	1884	366	2250	15.6
Mashpee	294	89	1506	1889	258	2147	12.9
Orleans	164	106	183	453	599	1052	7.7
Provincetown	444	25	94	563	473	1036	15.8
Sandwich	450	95	650	1195	1002	2197	7.7
Truro	967	63	448	1478	169	1647	11.8
Wellfleet	749	222	282	1253	845	2098	15.4
Yarmouth	444	139	470	1053	1212	2265	13.8
			Islands				
Chilmark	52	155	948	1155	109	1264	10.6
Edgartown	123	125	1062	1310	512	1822	9.6
Gay Head	40	154	264	458	18	476	11.7
Gosnold	91	322	181	594	29	623	7.0
Nantucket	538	1017	853	2408	708	3116	9.9
Oak Bluffs	42	13	69	124	94	218	4.1
Tisbury	74	17	5	96	11	107	2.2
West Tisbury	81	84	309	474	0	474	2.8

Wetlands are important for flood control, wildlife habitats, and to a lesser degree for water quality, and groundwater aquifer protection, recreation and visual quality. In addition, wetlands are extremely poor sites for industrial, commercial, and residential development because of high water tables, the flooding hazard, and the possibility of organic materials in the soils underlying the foundation. High water tables eliminate the use of septic tank and leach field systems for onsite sewage disposal, create serious site drainage problems, and make the use of building basements impractical and often impossible. The presence of organic material--muck or peat--in a foundation often results in differential settlement and cracking of the structure or fill. Removal of mucks and peats, particularly deep deposits, is usually a necessity for all but the lightest of fills or structures.

Wetlands act as natural floodwater retarding basins which store floodwaters and, thus, lower downstream peak flood flows. Loss of these storage areas can result in higher flood peaks and more extensive flooding downstream.

Many wildlife species depend directly on wetlands for food and habitat. As a result, wetlands provide many opportunities for recreational activities, such as hunting and wildlife observation.

Stream water quality can be either adversely or advantageously modified by wetlands. An example of adverse modifications can occur when wetland aquatic plants die and decay. During this decomposition, dissolved oxygen can be lowered to inadequate levels to sustain fish and other aquatic animal life. Often, this situation is triggered by nutrient loadings from upstream domestic or industrial waste water effluents. Wetlands can also enhance water quality by acting as sediment traps and nutrient filters. The quality of the incoming water and the condition of the wetland must be known to determine how a particular wetland will effect water quality.

In the region, with the exception of Cape Cod and the Islands, the major groundwater aquifers are in the bottom lands or flood plains along or near the major streams. These aquifers are often surfaced by wetlands. A measure of protection to underlying aquifers can be provided by maintaining these wetlands.

Most inland wetlands, during normal or dry periods, act as areas of groundwater discharge. During times of flood, however, there is the possibility of recharge into groundwater storage areas through their wetlands cover. Also, the storing of floodwater in upland wetlands and the releasing of lower flows for a longer period of time from them may allow advantageous recharge conditions to develop downstream.

The Massachusetts Water Resources Study has evaluated nearly 85 of the largest inland wetlands in the Coastal Region. The wetlands were studied for their value for flood control, timber production, wetland wildlife habitat, recreation, visual quality, and uniqueness. The methodology and

criteria employed in the evaluation is discussed in Appendix B. Results of the evaluation are presented in Table 5.16. Figure 5.13 indicates the location of the wetlands which were investigated.

The wetland evaluations are not intended to be used as the sole tool to rank wetlands within the region, nor should a "Low" rated wetland be considered a prime candidate for filling and development. Rather, the ratings can be used to indicate those wetlands which are obviously important to the water resources of the region. Wetlands which are rated "High" for a number of categories should also appear high on a list of wetlands to be acquired by government, or protected by restrictions or conservation easements. Wetlands which are rated "Low" in most categories may not be too important from a water resources standpoint. However, the criteria used in evaluating the wetlands has a great effect on the final rating. There may be specific wetland characteristics which would make a low rated wetland important to a particular community or interest group. The wetland evaluation, in effect, is one aid to establishing priorities in wetlands protection. A caution needs to be reemphasized at this point. Even a wetland which rates "Low" for all evaluated purposes should not be considered suitable for development. Because of the severe limitations imposed by wet conditions, wetlands can also be rated "Low" for suitability for development. Flood hazards, year-round problems with standing water, foundation problems, and septic system failures are among the problems to be faced by those owning developed property located on former wetlands.

Public ownership and the zoning of privately owned wetlands are important facets of the wetlands picture in the region. Publicly owned wetlands are usually more secure from encroachment and development than privately owned areas. Many towns in the region have acquired wetlands as conservation areas. In other instances, state forests, parks, and wildlife areas encompass wetlands. Zoning bylaws can also be a major determinant of the future of a wetland. A wetland area zoned for industrial development is in much more danger than an area zoned as flood plain land or that in a conservancy zone.

Public ownership information has been obtained for the wetlands of the region. Public ownership and zoning data have also been obtained for the 85-wetlands evaluated for various purposes. Wetland ownership and zoning data are presented in Tables 5.17 and 5.18.

Some interesting conclusions can be drawn from the ownership and zoning data. Public or quasi-public ownership of the evaluated wetlands is about twice as high as for all wetlands. This is probably because the evaluated wetlands are some of the largest wetland areas and so are very visible to the public and government. Many of the large evaluated wetlands are known far beyond their local area. Thus, it is conceivable that wetland acquisition naturally starts with the larger, better known areas. The larger areas are also better candidates for state agency acquisition, since they offer

TABLE 5.16 - SUMMARY OF WETLAND EVALUATION RESULTS
NORTHEASTERN SECTION

Wetland No.	Location Description	Wetland Size (Acres)	Wetland Types (Acres)							Evaluation Rating for:						
			1	2	3	4	5	6	7	Forest Management	Flood Control	Fish Habitat	Wetland Wildlife Habitat	Recreation	Uniqueness	Visual Quality
1	Little River Wetland in Newbury, West Newbury, and Newburyport, MA	500		310	110	10		30	40	Mod.	Low	N.R.	High	Mod.	High	Mod.
2	Wetland between Boxford St. and Lacy Street in North Andover, MA	440	20						420	High	Mod.	N.R.	Mod.	Low	Low	Mod.
3	Wenham Swamp in Hamilton, Topsfield & Wenham, MA	1970			130	60		300	1480	High	Mod.	N.R.	High	High	High	High
4	Willowdale State Forest Wetland in Ipswich, MA	610			10	10		10	580	High	Low	N.R.	Mod.	Mod.	High	Mod.
5	Miles River Wetland in Hamilton, MA	400			30			250	120	High	Low	N.R.	High	Mod.	Low	Mod.
6	Ipswich River Wetland in Wilmington, Reading & North Reading, MA	660	40					190	430	High	High	N.R.	Mod.	Mod.	High	Mod.
7	Cedar Swamp in No. Reading, Reading & Lynnfield, MA	910			10			10	890	High	High	N.R.	Mod.	Low	High	Mod.
8	Wetland Northeast of Interchange 33 on Route 128 in Lynnfield and Wakefield, MA	480	10		60	40		330	40	Mod.	Mod.	N.R.	High	Mod.	Mod.	Mod.
9	North Lynnfield Wetland in Lynnfield, MA	220						10	210	High	Low	N.R.	Mod.	Low	Low	Mod.
10	Orne Swamp on both sides of Route 95 in Topsfield, Middleton and Boxford, MA	340		10	10			100	220	High	Low	N.R.	High	Low	Low	Mod.
11	Cedar Swamp, north of Route 128 in Manchester and Essex, MA	160						10	150	High	High	N.R.	Low	Low	Low	Mod.
12	Beaver Pond Wetland in the "Centerville" section of Beverly, MA	60					20		40	Mod.	Low	Low	Mod.	Mod.	Low	Mod.
13	Burlington Mall Wetland in Burlington, MA	220						70	150	High	High	N.R.	Low	Low	Low	Mod.
14	Thompson's Meadow in Salem, MA	60			30	5		20	5	Low	Low	N.R.	Mod.	Low	High	Mod.
15	Swamp River Wetland in Weymouth, Hingham & Rockland, MA	280							280	High	Mod.	N.R.	Mod.	Low	Low	Mod.
16	Mine Brook Wetland in Walpole & Medfield, MA	160	40		10			10	100	High	Mod.	N.R.	Mod.	Low	High	Mod.
17	Stop River Wetland in Walpole, Norfolk & Medfield	190	70						120	High	Low	N.R.	Mod.	Low	Low	Mod.
18	Neponset River Wetland on both sides of Rte. 128 in Westwood, Canton and Dedham, MA	950	300		10	10		30	600	High	Mod.	N.R.	Mod.	Low	High	Mod.
19	Neponset River Wetland on both sides of Rte. 95 in Norwood, Canton and Sharon, MA	1800	500		30			90	1180	High	Mod.	N.R.	Mod.	Low	High	High
20	Cochato River Wetland in Holbrook, Braintree and Randolph, MA	380		5	20	10		120	225	High	Mod.	N.R.	Mod.	Mod.	Low	Mod.
21	Bear Swamp in Randolph, Stoughton & Avon, MA	230							230	High	High	N.R.	Mod.	Low	Low	Mod.
22	Cedar Swamp, southeast of Rte. 1A in Walpole, MA	570						20	550	High	Mod.	N.R.	High	Mod.	High	Mod.
23	Witch Pond Swamp in Foxborough and Mansfield, MA	130	5	5		5	5	10	100	High	Mod.	Low	Mod.	Mod.	Low	Mod.
24	Canoe River Wetland in Norton, Mansfield and Easton, MA	190		30				10	150	High	Mod.	N.R.	Mod.	Low	Low	High
25	Sharon Heights Wetland west of Massapoag Lake in Sharon, MA	320							320	High	Low	N.R.	Low	Low	Low	Mod.

TABLE 5.16 - SUMMARY OF WETLAND EVALUATION RESULTS
NORTHEASTERN SECTION

Wetland No.	Location Description	Wetland Size (Acres)	Wetland Types (Acres)							Evaluation Rating for:						
			1	2	3	4	5	6	7	Forest Management	Flood Control	Fish Habitat	Wetland Wildlife Habitat	Recreation	Uniqueness	Visual Quality
26	North River Wetland in Norwell, Pembroke, and Marshfield, MA	650			630	10			10	N.R.	N.R.	Mod.	High	Mod.	High	Mod.
27	Hockomock Swamp in Easton, West Bridgewater, Taunton, and Raynham, MA	5450	60		300	350	10	350	4380	High	High	Mod.	High	High	High	High
28	Beech Hill Swamp in Rockland, Hanover, and Hanson, MA	550	100					10	440	High	High	N.R.	High	Low	High	High
29	Bear Meadow Wetland in Whitman, MA	130						120	10	Mod.	Low	N.R.	Mod.	Low	Low	Low
30	Great Cedar Swamp in Halifax & Hanson, MA	1470			400	180		140	750	High	Mod.	N.R.	High	High	High	High
31	Herring Brook Wetland in Pembroke, MA	710	90		30			120	470	High	Low	N.R.	High	Low	High	Mod.
32	Peterson Swamp in Halifax and Plympton, MA	410							410	High	Low	N.R.	Mod.	Low	Low	Mod.
33	Phillips Brook Wetland west of Rte. 3 in Duxbury	420			10	20		170	220	High	Mod.	Low	Mod.	Mod.	Low	Mod.
34	Bungay River Wetland in Attleboro and North Attleborough, MA	380						20	360	High	High	N.R.	Mod.	Low	High	Mod.
35	Hemlock Swamp in Rehoboth, Attleboro & Norton,MA	790			10			10	770	High	Low	N.R.	Mod.	Low	High	Mod.
36	Chartley Brook Wetland in Attleboro & Norton, MA	600			20			130	450	High	Mod.	Low	High	Mod.	High	High
37	Titicut Swamp in Bridgewater & Raynham, MA	430			30	30	20		350	High	Mod.	Mod.	High	Mod.	High	High
38	Pine Swamp in Raynham and Taunton, MA	540			20			60	460	High	Mod.	N.R.	Mod.	Low	High	Mod.
39	Great Cedar Swamp in Middleborough & Halifax, MA	720	10						710	High	Mod.	N.R.	Mod.	Low	High	Mod.
40	Winnetuxet River Wetland in Halifax & Plympton,MA	710	80	10	10	10		220	380	Mod.	Mod.	Mod.	High	Mod.	High	High
41	Turkey Swamp in Halifax and Plympton, MA	850	10		10			10	820	High	Mod.	N.R.	High	Low	High	Mod.
42	Cedar Swamp in Carver, MA	750			30			40	680	High	Low	N.R.	High	Low	High	Mod.
43	Manwhague Swamp in Rehoboth, MA	620							620	High	Mod.	N.R.	Mod.	Low	High	Low
44	Squannakonk Swamp in Rehoboth, MA	460						10	450	High	Mod.	N.R.	Mod.	Low	Low	Mod.
45	Nemasket River Wetland in Middleborough and Lakeville, MA	490	180					20	290	High	Low	Mod.	High	Low	Low	High
46	Hobomock Swamp & Bolton Cedar Swamp in New Bedford and Freetown, MA	780			10				770	High	Low	N.R.	Mod.	Low	High	Mod.
47	New Bedford Reservoir Wetland in Acushnet, MA	310				80		50	180	High	Low	Mod.	High	Mod.	High	Mod.
48	Rocky Gutter Brook Wetland in Middleborough, MA	1000				10		50	940	High	Mod.	N.R.	High	Low	High	High
49	Forbes Swamp in Rochester & Middleborough, MA	560			60	10		70	420	Mod.	Low	Mod.	High	Mod.	High	High
50	Cedar Swamp in Rochester, MA	690			10			40	640	High	Low	N.R.	High	Low	High	Mod.
51	Maple Swamp in Wareham, MA	130			40			10	80	High	N.R.	N.R.	Mod.	Low	Low	Mod.
52	Copicut Swamp in Fall River, MA	450							450	High	Low	N.R.	Mod.	Low	Low	Mod.
53	Shingle Island Swamp & Colebrook Swamp in Dartmouth, MA	750	10					10	730	High	Mod.	N.R.	Mod.	Low	Low	Mod.
54	Acushnet Cedar Swamp in New Bedford, MA	1070	10			20			1040	High	Mod.	Mod.	Mod.	Mod.	High	High
55	Apponagansett Swamp in Dartmouth & New Bedford	750	20					70	660	High	Mod.	N.R.	Mod.	Low	High	Mod.
56	Paskamanset River Wetlands in Dartmouth, MA	800		10	20			10	760	High	Low	N.R.	High	Low	High	High
57	Haskell Swamp in Rochester & Mattapoisett, MA	330							330	High	Low	N.R.	Mod.	Low	Low	Mod.
58	Deerfield Swamp in Dartmouth, MA	540							540	High	Low	N.R.	Mod.	Low	Low	Mod.

TABLE 5.16 - SUMMARY OF WETLAND EVALUATION RESULTS
NORTHEASTERN SECTION

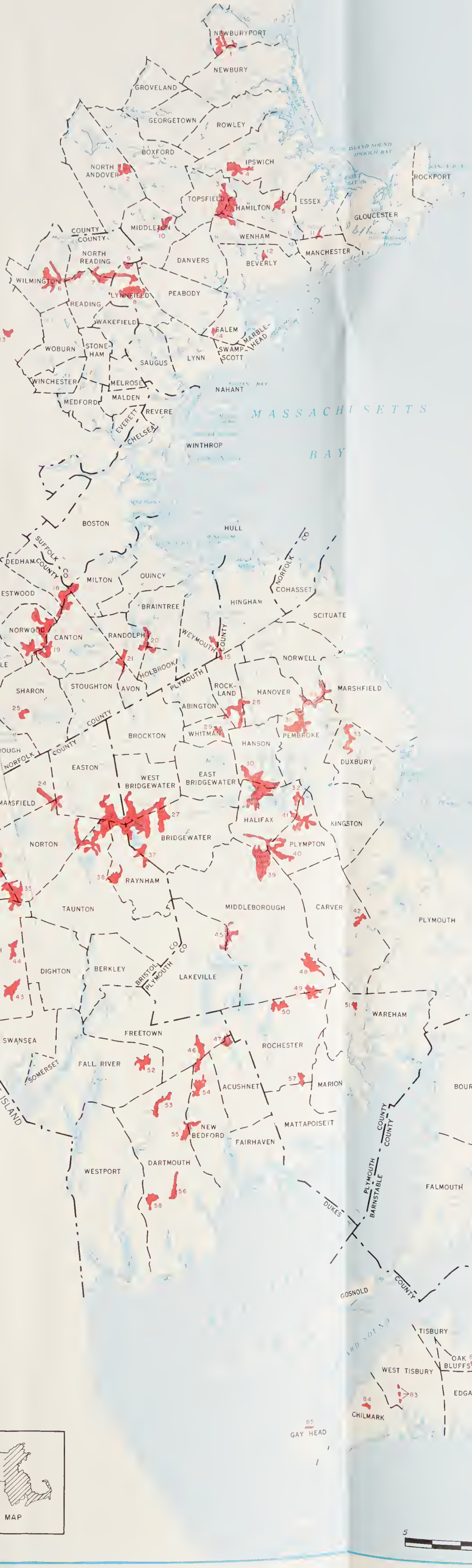
Wetland No.	Location Description	Wetland Size (Acres)	Wetland Types (Acres)							Evaluation Rating for:						
			1	2	3	4	5	6	7	Forest Management	Flood Control	Fish Habitat	Wetland Wildlife Habitat	Recreation	Uniqueness	Visual Quality
59	Clapps Pond Wetland in Provincetown, MA	70			20			40	10	Low	N.R.	N.R.	Mod.	Low	Low	Mod.
60	Shank Painter Pond Wetland in Provincetown, MA	80			50	10		20		N.R.	N.R.	N.R.	High	Low	High	Mod.
61	Pilgrim Lake Wetland in Truro, MA	290			200			90		N.R.	N.R.	Low	High	Low	High	Mod.
62	Little Pamet Wetland in Truro, MA	80	10		60			10		N.R.	N.R.	N.R.	Mod.	Low	High	Mod.
63	Truro River Wetland in Truro, MA	220	60		130			30		N.R.	N.R.	Mod.	High	Low	High	Mod.
64	Herring River Wetland in Truro & Wellfleet, MA	350	170		10			170		N.R.	N.R.	Mod.	High	Mod.	High	Mod.
65	Duck Harbor Wetland in Wellfleet, MA	400	170		80			150		N.R.	N.R.	Mod.	High	Mod.	High	Mod.
66	Namskaket Creek Wetland in Brewster & Orleans, MA	35			20	5			10	Mod.	N.R.	N.R.	Mod.	Low	Low	Mod.
67	Chathamport Wetland in Chatham, MA	50			35		5	10		N.R.	N.R.	Low	Mod.	Low	Low	Mod.
68	Grass Pond Wetland in Harwich, MA	90	5		15	15		55		N.R.	Low	N.R.	Mod.	Low	High	Low
69	Wetland between Othrop Rd. & Sisson Rd. in Harwich	80		15	15			10	40	High	N.R.	N.R.	Mod.	Low	Low	Mod.
70	Swan Pond River Wetland in Dennis, MA	140			40			30	70	High	N.R.	Mod.	Mod.	Low	Low	Low
71	Ware Creek Wetland in Dennis, MA	80						25	55	Mod.	N.R.	N.R.	Low	Low	Low	Low
72	Parkers River Wetland in Yarmouth, MA	80			30			30	20	Mod.	N.R.	Mod.	Mod.	Low	Low	Low
73	Whitcomb Swamp in Mashpee, MA	55			25				30	Mod.	Low	Mod.	Mod.	Low	Low	Mod.
74	Sagamore Beach Wetland in Sandwich & Bourne, MA	230						170	60	Low	N.R.	N.R.	Low	Low	Low	Low
75	Savam Swamp in Nantucket, MA	90						30	60	Mod.	N.R.	N.R.	Low	Low	High	Low
76	Wetland near Polpis Section of Nantucket, MA	80			10	10	5	35	20	Mod.	N.R.	Mod.	Mod.	Low	High	Mod.
77	Phillips Run Swamp in Nantucket, MA	60	40						20	Low	N.R.	N.R.	Low	Low	Mod.	Mod.
78	Head of Hummock Wetland in Nantucket, MA	60						45	15	Mod.	N.R.	Low	Mod.	Low	Low	Mod.
79	Trots Swamp in Nantucket, MA	120			10			60	50	Mod.	N.R.	N.R.	Mod.	Low	Low	Mod.
80	Long Pond Wetland in Nantucket, MA	100	10		30				60	Low	N.R.	Low	Mod.	Low	Low	Mod.
81	Beetle Swamp in Edgartown, MA	16			2				14	Mod.	N.R.	N.R.	Mod.	Low	High	Mod.
82	Majors Cove Wetland in Oak Bluffs, MA	18			5			13		N.R.	N.R.	N.R.	Mod.	Low	High	Mod.
83	Mill Brook Wetland in West Tisbury, MA	40	25				5		10	Mod.	N.R.	Mod.	Mod.	Mod.	High	Mod.
84	Tiasquan River Wetland in Chilmark, MA	32						6	26	High	Low	N.R.	Mod.	Low	Low	Mod.
85	Lobsterville Wetland in Gay Head, MA	39						22	17	N.R.	N.R.	N.R.	Mod.	Low	Low	Mod.

FIGURE 5.13

EVALUATED WETLANDS

LEGEND

52 EVALUATED WETLAND



1-12,803

TABLE 5.17 - EVALUATED WETLANDS SUMMARY

Subregion	Area of Evaluated Wetlands (Acres)	Percent Subregion Wetlands	Area in Public or Quasi-Public Ownership (Acres)	(Percent)	Area in Conservancy Zones (Acres)	(Percent)	Total Publicly Owned or in Conservancy Zones (Acres)	(Percent)
Northeast	12,038	27.2	3,974	33.0	4,997	41.5	8,971	74.5
Southeast	25,488	24.6	7,133	28.0	3,902	15.3	11,035	43.3
Cape Cod & Islands	3,075	26.6	1,484	48.3	306	10.0	1,790	58.2
Total	40,601	25.5	12,571	31.0	9,205	22.7	21,796	53.7

TABLE 5.18 - OWNERSHIP, RESTRICTIONS[1/], AND PROTECTIVE ZONING[2/] OF INLAND WETLANDS

Subregion	Total Area Inland Wetlands (Acres)	Public & Quasi-public Ownership (Acres)	Percent of Total[5/]	Inland Wetland Restrictions[3/] (Acres)	Percent of Total[5/]	Protective Zoning[4/] (Acres)	Percent of Total[5/]	Total Public Ownership Protective Zoning & Wetlands Restrictions (Acres)	Percent of Total[5/]
Northeast	44,270	6,470	14.6	1,870	4.2	13,760	31.1	22,100	49.9
Southeast	103,660	13,150	12.7	--	--	29,530	28.5	42,680	41.2
Cape Cod & Islands	11,580	3,120	26.9	480	4.2	2,690	23.2	6,290	54.3
Total	159,510	22,740	14.3	2,350	1.5	45,980	28.8	71,070	44.6

1/ Massachusetts General Laws, Chapter 131, Section 40A.

2/ Municipal flood plain conservancy, watershed protection or similar zoning which restricts development activity in wetlands.

3/ Publicly or Quasi-publicly owned wetlands have been subtracted from these figures.

4/ Publicly or Quasi-publicly owned and inland wetland restriction totals have been subtracted from these figures.

5/ Total area of subregion inland wetlands.

more management possibilities than the smaller areas. This acquisition of the large wetlands has been a pleasant circumstance since, in many cases, the larger areas are more diversified and offer more varied wildlife habitat.

Also interesting is the fact that Cape Cod and the Islands, with the lowest percentage of wetlands under protective zoning, have the highest percentage of publicly owned wetlands. It appears that much of the credit for protecting wetland areas in this part of the region is due to the acquisition program of the National Park Service in conjunction with the Cape Cod National Sea Shore. The Martha's Vineyard Commission has a unique set of regulations for protecting coastal wetlands and wetlands bordering streams draining into Great Ponds. Acquisitions by the Sherriff's Meadow Foundation and Nantucket Conservation Foundation are an important part of the protection of wetlands on the Islands.

5.6 WATER QUALITY[16/]

In 1975, according to the SENE study, "two-thirds of major stream miles in the SENE region were below state standards, as were most waters in urban harbors." The SENE study also forecast that "by 1977, most of these waters--except those bearing the heaviest pollution burdens--will be fishable, and many will be swimmable." This tremendous progress in meeting water quality standards was, of course, due to the vast expenditures by the public and private sector for advanced wastewater treatment facilities.

Nearly 75 percent of the region's population is served by municipal sewerage systems, with the remaining 25 percent relying on individual septic systems. Pollution of rivers and harbors is especially bad near the urban areas of the region. Industrial wastes, combined sanitary-storm sewers and poorly treated municipal waste treatment discharges are the major water pollution problems. Table 5.19 gives a good picture of the relative magnitude of the water quality situation in various subbasins of the Coastal Region.

On a regionwide basis, SENE found the six major sources of water pollution, in order of decreasing significance, to be: 1. combined sewer overflows and urban stormwater runoff; 2. municipal discharge; 3. industrial discharges; 4. nonpoint pollution sources; 5. oil pollution; and 6. watercraft wastes.

Sources of water pollution are normally placed into two major categories: point or nonpoint sources.

Point sources are those where a large quantity of pollutants is discharged into a stream from a discrete, readily identifiable source. The most common examples of point sources include discharges from wastewater treatment plants and industrial plants.

TABLE 5.19 KEY DETERMINANTS OF WATER QUALITY

PLANNING AREA	Determinants of Water Quality: Combined Sewers/Urban Runoff	Municipal Discharges	Industrial Discharges	Low Streamflow	Septic Systems	Agricultural Runoff	Landfill Leachate	Oil Pollution	Watercraft Wastes	Overall Severity: Relevative Severity of Water Quality Problem — All Discharges, combined for the Planning Area as a whole.
Ipswich - North Shore	.	0	.	0	●		0	.	.	0
Boston Metropolitan	●	●	●	.			0	●	.	●
South Shore		0	.	0	0	.			.	0
Cape Cod & Islands		0			●	.			0	.
Buzzards Bay	●	●	0		.	0			.	0
Taunton	0	●	●	0	0	0		.		●
Narragansett Bay	●	0	.					0	0	0

● = Major determinant 0 = Intermediate determinant . = Minor determinant

Source: Report of the Southeastern New England Study - Regional Report New England River Basins Commission, Boston, Massachusetts, 1975, p. 5-3.

Nonpoint sources are more difficult to isolate. They usually involve relatively small quantities of pollutants which are discharged over relatively large areas. Examples of nonpoint sources include salt runoff from highways, animal wastes from agricultural enterprises, sediment from accelerated erosion problem areas, fertilizer and pesticide runoff from agricultural use, effluent from inadequate septic systems, and leachate from poorly situated or managed landfills or dumps.

Section 208 of Public Law 92-500, the Water Pollution Control Act, Amendments of 1972, authorized the preparation of Water Quality Management Plans for designated areas of the country. In the Coastal Region, most of the towns are within a designated "Areawide Waste Treatment Management Area." See Figure 5.14 for the location of these areas.

Major objectives of most of these "208" studies will be to assess the effectiveness of the installed or planned treatment of point pollution sources and the evaluation of the magnitude and seriousness of the nonpoint problem. Tentative solutions to water quality problems will also be formulated. Studies in other parts of the United States have shown that nonpoint sources may produce half of the pollution observed. The "208" studies will attempt to determine how true this is for the Coastal Region.

Sewer service is provided to the areas indicated on Figure 5.15. Individual subsurface sewage disposal systems are relied on exclusively by the other areas. Even in towns with some municipal sewer service, residents in outlying areas must make use of individual septic tank-leach field systems.

In most cases, an adequately designed individual disposal system is able to treat and dispose of domestic sewage with little adverse effect on the groundwater. Unfortunately, many of the older systems in the region are inadequately designed. Also, septic systems usually do not remove significant amounts of nutrients, such as phosphates and nitrates. An additional problem can be the adequate disposal of sludge from septic tank cleanouts.

In addition, soil conditions in much of the area are unsuitable for septic tank systems. Seasonally high water table, bedrock or hardpan, and low soil permeability are the most common limitations on the use of individual disposal systems. Table 5.20 indicates results extracted from detailed soil surveys in 54 of the region's towns. A large percentage of the developable land in these towns has "severe" limitations for onsite septic tank disposal systems.

Agriculture-related pollution can result from two main sources: animal wastes and runoff containing residues of fertilizer, pesticides, and herbicides. In the Coastal Region, cattle, hogs, and chickens represent the largest potential source of animal waste pollution. In 1974, there were over 25,800 cattle, 18,800 hogs, and 400,000 chickens in the region. Nearly half of this livestock was located in Bristol County.[17]

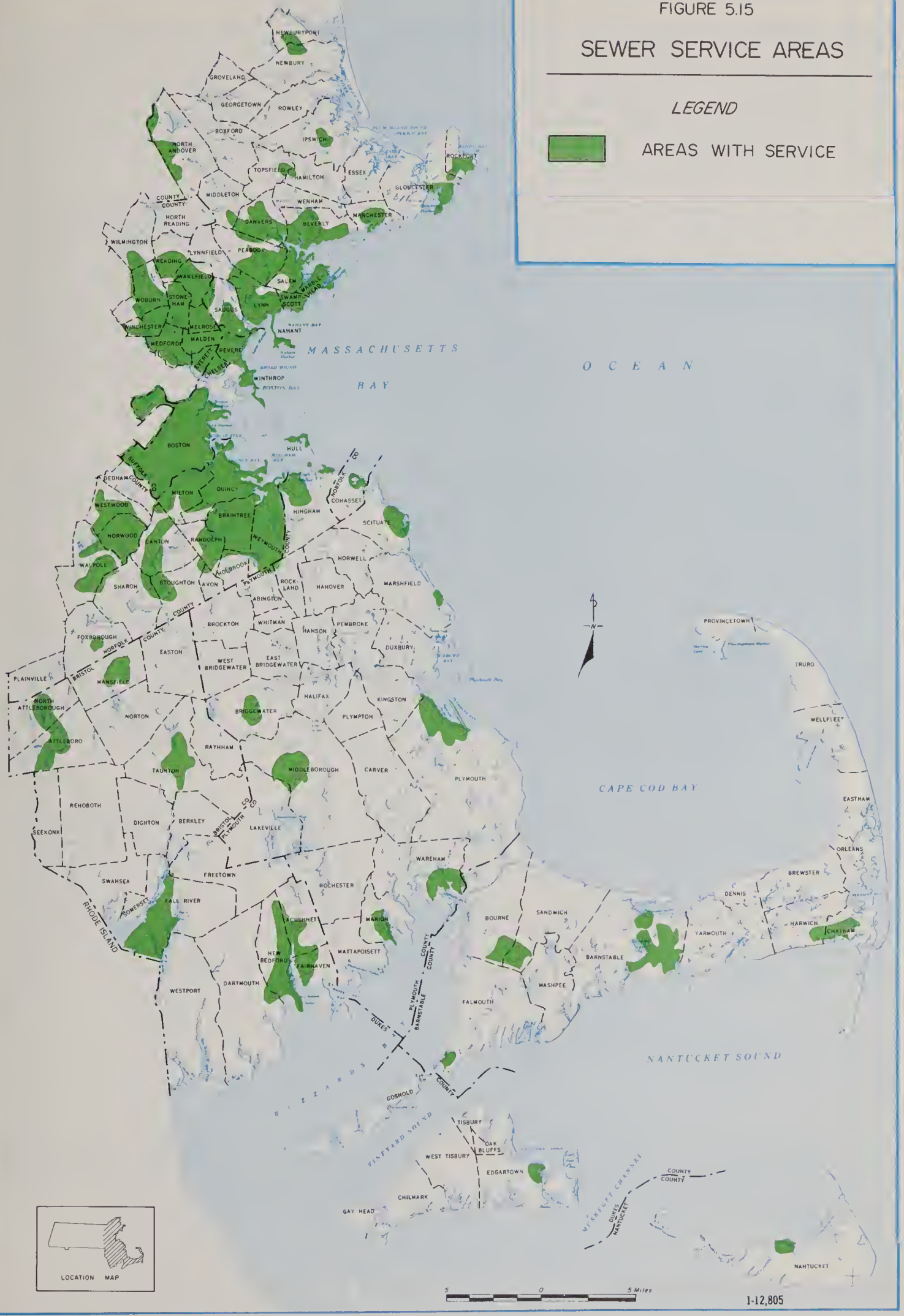


FIGURE 5.14

DESIGNATED WASTE TREATMENT MANAGEMENT AREAS

TABLE 5.20 - LIMITATIONS FOR ONSITE SEPTIC TANK DISPOSAL SYSTEMS[1/]

City/Town	Town Area	Area Mapped	Limitations for Septic Tanks			Percent of Mapped Area with Severe Limitation
			Slight	Moderate	Severe	
			- - - - ACRES - - - -			
			Taunton River Basin			
Bridgewater	18,183	16,864	3,826	1,580	11,458	68
Dighton	14,252	13,876	765	1,022	12,089	87
East Bridgewater	11,079	11,123	2,077	657	8,389	75
Easton	18,412	18,083	3,525	3,247	11,311	63
Foxborough	13,032	12,896	1,960	1,145	9,791	76
Halifax	11,069	9,929	2,746	1,033	6,150	62
Hanson	9,971	9,495	2,114	985	6,396	67
Lakeville	22,892	18,984	4,757	3,533	10,694	56
Mansfield	12,942	12,436	3,721	2,376	6,339	51
Middleborough	46,418	44,747	10,813	6,178	27,756	62
Norton	18,571	17,523	5,439	1,747	10,337	59
Plympton	9,632	9,286	1,712	1,226	6,348	68
Taunton	29,586	25,496	1,718	8,717	15,061	59
West Bridgewater	9,893	9,896	1,548	263	8,085	82
			Ten Mile Basin			
North Attleborough	12,586	10,348	1,416	1,035	7,897	76
Seekonk	12,089	10,516	2,665	700	7,151	68
			Cape Cod & Islands			
Barnstable	40,984	38,001	19,952	5,915	12,134	32
Brewster	18,976	13,023	4,800	3,304	4,919	38
Chilmark	12,991	11,456	1,986	1,691	7,644	67
Falmouth	31,504	23,316	11,642	3,749	7,925	34
Nantucket	31,580	31,580	16,576	3,042	9,288	29
Orleans	14,007	7,025	3,294	1,302	2,429	35
Yarmouth	16,448	15,892	10,546	1,873	3,473	22
			South Shore Coastal Area			
Braintree	9,100	8,035	353	16	7,666	95
Cohasset	6,412	6,093	30	14	6,049	99
Duxbury	15,454	14,997	6,040	3,646	5,311	35
Hingham	14,501	12,848	2,156	930	9,762	76
Holbrook	4,769	4,029	507	798	2,724	68
Marshfield	18,678	17,221	3,129	2,888	11,204	65
Norwell	13,133	13,480	2,211	728	10,541	78
Pembroke	15,284	13,689	3,594	2,850	7,245	53
Plymouth	62,915	62,433	12,274	9,765	40,394	65
Randolph	6,569	5,332	946	1,768	2,618	49
Rockland	6,421	5,091	749	769	3,573	70
Scituate	11,281	10,201	596	109	9,496	93
			Buzzards Bay Area			
Carver	27,504	23,001	8,538	5,076	9,387	41
Marion	9,105	9,089	909	3,343	4,837	53
Mattapoisett	11,136	11,019	740	2,844	7,435	67
Wareham	23,745	22,872	9,949	5,669	7,254	32
			Ipswich-North Shore Basin			
Oxford	15,759	13,947	1,927	2,599	9,421	68
Groveland	6,080	5,400	470	430	4,500	83
Ipswich	23,204	13,986	1,877	1,368	10,741	77
Manchester	4,984	4,618	211	30	4,377	95
Newbury	16,224	10,009	485	575	8,949	89
Newburyport	6,616	4,844	1,374	193	3,277	68
North Andover	17,852	16,277	756	2,025	13,496	83
Rowley	12,767	9,249	1,411	1,036	6,802	74
Topsfield	8,188	7,853	1,181	1,112	5,560	71
North Reading	8,680	7,910	925	2,214	4,771	60
			Neponset Basin			
Canton	12,460	10,310	1,623	1,264	7,423	72
Sharon	15,432	15,121	2,632	784	11,705	77
Stoughton	10,492	9,799	2,579	1,866	5,354	55
Walpole	13,330	12,623	1,984	1,841	8,798	70
Westwood	7,118	6,269	383	896	4,990	80
			Narragansett Bay Area			
Rehoboth	30,493	30,078	3,902	5,285	20,891	69
Swansea	14,595	13,198	1,396	570	11,232	85


FIGURE 5.15
SEWER SERVICE AREAS
LEGEND
AREAS WITH SERVICE
MASSACHUSETTS BAY
OCEAN
CAPE COD BAY
NANTUCKET SOUND
VINEYARD SOUND
RHODE ISLAND
NEWBURYPORT
NEWBURY
GROVELAND
GEORGETOWN
ROWLEY
BOXFORD
IPSWICH
ROCKPORT
NORTH ANDOVER
TOPSFIELD
HAMILTON
ESSEX
GLOUCESTER
MIDDLETON
WENHAM
MANCHESTER
DANVERS
BEVERLY
WILMINGTON
LYNNFIELD
PEABODY
READING
WAKEFIELD
SALEM
WOBURN
STONEHAM
SAUGUS
LYNN
SWAMPSCOTT
WINCHESTER
MELROSE
NAHANT
MEDFORD
MALDEN
REVERE
EVERETT
CHELSEA
WINTHROP
BOSTON
HULL
DEDHAM
MILTON
QUINCY
COHASSET
WESTWOOD
BRAINTREE
HINGHAM
SCITUATE
NORWOOD
CANTON
RANDOLPH
WEYMOUTH
HORWELL
WALPOLE
STOUGHTON
AVON
HOLBROOK
ROCKLAND
HANOVER
MARSHFIELD
SHARON
ABINGTON
BROCKTON
WHITMAN
HANSON
PEMBROKE
FOXBOROUGH
EASTON
DUXBURY
WEST BRIDGEWATER
EAST BRIDGEWATER
PLAINVILLE
MANSFIELD
HALIFAX
KINGSTON
NORTH ATTLEBOROUGH
NORTON
BRIDGEWATER
PLYMPTON
ATTLEBORO
RAYNHAM
TAUNTON
MIDDLEBOROUGH
CARVER
PLYMOUTH
REHOBOTH
DIGHTON
BERKLEY
SEEKONK
LAKEVILLE
WAREHAM
FREETOWN
SWANSEA
ROCHESTER
FALL RIVER
SOMERSET
LACUSHNET
MARION
BOURNE
SANDWICH
NEW BEDFORD
FAIRHAVEN
MATTAPOISETT
BARNSTABLE
MASHPEE
WESTPORT
DARTMOUTH
FALMOUTH
GOSNOLD
TISBURY
OAK BLUFFS
WEST TISBURY
EDGARTOWN
CHILMARK
GAY HEAD
NANTUCKET
PROVINCETOWN
TRURO
WELLFLEET
EASTHAM
ORLEANS
BREWSTER
DENNIS
HARWICH
CHATHAM
YARMOUTH
SUFFOLK CO.
NORFOLK COUNTY
PLYMOUTH COUNTY
BRISTOL CO.
BARNSTABLE COUNTY
DUKES COUNTY
NANTUCKET COUNTY
LOCATION MAP
5 0 5 Miles
1-12,805

Unless properly managed, animal wastes present a water quality hazard. Because of the size of farms in the area and their location in relation to watercourses, animal waste is not a dominant pollution source in the region. However, according to the SENE study, agricultural runoff was considered to be an intermediate determinant of water quality in Bristol County. Proper manure storage and disposal techiques are expected to control the pollution hazard in the future.

Heavy use of commercial fertilizer is another agriculture-related nonpoint source of pollution. Fertilizer which is not utilized by crops can become a potential hazard, if washed into waterways, ponds, or lakes. In 1974, nearly 5,600 tons of commercial fertilizer were used on the farms in the region.[18/] Almost half of this fertilizer was used on pasture, hayland, or cornfields. The high cost of fertilizer and the relatively low-value crops tend to minimize fertilizer as a significant pollution source. Once again, Bristol County accounted for nearly half of the commercial fertilizer used in the region. Significant tonnages of fertilizer were also used in Essex and Plymouth Counties.

Pesticides and herbicides represent another potential agricultural pollution source. In 1974, farm operators spent over $700,000 for sprays, dusts, and fumigants to control insects and diseases in crops and pastures. Over half of the dollar value for pesticides and herbicides was expended in Plymouth County, most likely by cranberry growers. In view of the close proximity of cranberry bogs and watercourses, a high potential exists for water pollution from pesticides and herbicides.

The use of pesticides and herbicides in agriculture is not expected to be a significant pollution source in the noncranberry growing portions of the region. Pesticide use is regulated by the Pesticides Board, Massachusetts Department of Environmental Quality Engineering. The Extension Service has sponsored training sessions for growers to promote safe pesticide handling practices.

Forest management activities can also cause nonpoint pollution problems. This is true where recreation, improper grazing and poor road and trail layout and construction occur. Certain water quality parameters, including water temperature, turbidity, total dissolved solids, nitrate-nitrogen and fecal coliforms, may all be affected by the manner in which the watershed is managed. The severity is dependent on the particular management activities and the percentage of the watershed affected by the activities. Through proper planning, the effects of land management on water quality can be minimized.

5.7 WATER SUPPLY AND IRRIGATION

A. Water Supply

Communities in the Coastal Region meet their municipal water supply needs through ground water, surface supplies, and purchases from the Metropolitan District Commission (MDC) system. The present mix of water supply options being utilized and safe yields are shown in Table 5.21.

TABLE 5.21 - EXISTING MUNICIPAL WATER SUPPLY
NORTHEAST SECTION

Municipality	Safe Yield[1] (mgd)	Source or Supplier[2] Ground-water	Surface Reser-voirs	MDC
Beverly/Salem	11.4		x	
Boston	141.7			x
Boxford	private supplies	x		
Canton	4.0	x		x
Chelsea	3.6			x
Danvers/Middleton	7.8	x	x	
Essex	1.5	x		
Everett	8.0			x
Georgetown	1.3	x		
Gloucester	4.3		x	
Groveland	1.0	x		
Hamilton	1.9	x		
Ipswich	2.2	x	x	
Lynn	17.0		x	
Lynnfield	1.7	x		x
Malden	6.9			x
Manchester	2.3	x	x	
Marblehead	2.2			x
Medford	8.1			x
Melrose	3.0			x
Middleton	see Danvers	x	x	
Milton	2.5			x
Nahant	0.6[2]			x
Newbury	0.2[2]	x	x	
SOUTHEAST SECTION				
Abington/Rockland	4.4[5]	x	x	
Acushnet	0.4		x	
Attleboro	13.8	x	x	
Avon	0.6	x		
Berkley	private supplies	x		
Braintree	5.9	x	x	
Bridgewater	2.5[5]	x		
Brockton	12.0[5]		x	
Carver	private supplies	x		
Cohasset	1.2	x	x	
Dartmouth	2.5	x	x	
Dighton	0.7	x	x	
Duxbury	2.8	x		
E. Bridgewater	1.8	x		
Easton	2.7	x		
Fairhaven	2.5[5]	x	x	
Fall River	15.5[5]		x	
Foxborough	3.9[5]	x		
Freetown	0.1[5]	x		
Halifax	0.9	x		
Hanover	3.4	x		
Hanson	0.5		x	
Hingham/Hull	7.0	x		
Holbrook	see Randolph	x	x	
Hull	see Hingham	x		
Kingston	2.9	x		
Lakeville	0.3	x		
Mansfield	1.6	x		
Marion	1.4	x		
CAPE COD AND ISLANDS SECTION				
Barnstable	12.2	x		
Bourne	5.9	x		
Brewster	2.8	x		
Chatham	3.5	x		
Dennis	6.1	x		
Eastham	private supplies	x		
Falmouth	14.1	x	x	
Harwich	7.2	x		
Mashpee	1.7	x		
Orleans	2.1	x		
Provincetown	3.0	x		
Sandwich	1.6	x		

Municipality	Safe Yield[1] (mgd)	Source or Supplier[2] Ground-water	Surface Reser-voirs	MDC
Newburyport	2.0	x	x	
North Andover	3.0		x	
North Reading	1.3	x		
Norwood	7.5	x		
Peabody	10.2	x	x	x
Reading	5.9	x		
Revere	3.9			x
Rockport	0.8	x	x	
Rowley	0.9	x		
Salem	see Beverly		x	
Saugus	2.9			x
Sharon	3.7	x		
Stoneham	3.4			x
Swampscott	1.6			x
Topsfield	0.8	x		
Wakefield	5.2	x	x	x
Walpole	3.8	x		
Wenham	1.4[3]	x		
Westwood	9.3[3]	x		
Wilmington	7.1	x		
Winchester	2.9	x		x
Wintrhop	1.8			x
Woburn	13.2	x	x	
Marshfield	5.8	x		
Mattapoisett	2.1	x		
Middleborough	1.8	x		
New Bedford	20.0		x	
N. Attleborough	4.5	x		
Norton	2.1	x		
Norwell	1.9	x		
Pembroke	1.8	x	x	
Plainville	1.2	x		
Plymouth	5.5	x	x	
Plympton	private supplies	x		
Quincy	10.2			x
Randolph/Holbrook	7.6	x	x	
Raynham	0.8	x		
Rehoboth	private supplies	x		
Rochester	private supplies	x		
Rockland	see Abington	x	x	
Scituate	4.4	x	x	
Seekonk	3.4	x		
Somerset	5.3	x	x	
Stoughton	2.6	x		
Swansea	2.8	x		
Taunton	9.5		x	
Wareham	4.5[2]	x	x	
W. Bridgewater	1.9[2]	x		
Westport	private supplies[5]	x		
Weymouth	13.7	x	x	
Whitman	0.7		x	
Truro	see Provincetown	x		
Wellfleet	private supplies	x		
Yarmouth	6.9	x		
Chilmark	0.05	x		
Edgartown	5.2	x		
Gay Head	private supplies	x		
Gosnold	.15	x		
Nantucket	3.7	x		
Oak Bluffs	1.3	x		
Tisbury	2.5[4]	x		
West Tisbury	private supplies	x		

1/ Interim Report, Water Supply Policy Study, Executive Office of Environmental Affairs, October 1976.

2/ Report of the Southeastern New England Study, New England River Basins Commission, December 1975.

3/ Safe Yield of the Dedham Water Company which supplies Westwood.

4/ Martha's Vineyard Commission.

5/ Water Supply Study, Pawcatuk River and Narragansett Bay Drainage Basins, U.S. Army Corps of Engineers.

The area immediately north of Boston is almost exclusively served by the MDC. The northernmost part of the region relies heavily on groundwater, while the interface communities rely on a combination of sources with Peabody and Wakefield drawing their supply from all three. The towns immediately south of Boston obtain their supplies from the MDC, groundwater, or a combination of the two. Further south, communities obtain their water from groundwater and surface sources. The vast majority of communities in Plymouth and Bristol Counties rely on groundwater. Notable exceptions are the southern tier, including Somerset, Fall River, New Bedford, Taunton, Wareham, and Plymouth, which utilize surface sources exclusively or in conjunction with groundwater. The water supply for Cape Cod and the Islands is almost exclusively from groundwater.

B. Irrigation

Irrigation of agricultural crops utilizes about 14,000 acre-feet of water per year The major use of irrigation is in the production of cranberries, which is estimated to require nearly 13,000 acre-feet annually. The remaining 1,000 acre-feet is used primarily to irrigate high value nursery stock. Because of the over 42 inches of rainfall which the region receives, most other crops do not require irrigation for successful production. Agricultural irrigation data is presented in Table 5.22 for the counties comprising the Coastal Region.

TABLE 5.22 - IRRIGATED CROPLAND[19/]

County	Area Irrigated (acres)	Water Used (acre-feet)	Average Use (inches-acre)
Barnstable	892	697	9.4
Bristol	1,581	1,138	8.6
Dukes	48	25	6.2
Essex	1,162	818	8.4
Middlesex	1,576	1,049	8.0
Norfolk	351	236	8.1
Plymouth	8,930	9,963	13.4

The irrigation water figures in Table 5.22 only reflect water used during the growing season to provide moisture needed for plant growth. Cranberry growers also utilize a great deal of water throughout the year for frost protection, winter freeze protection, and harvesting. These water uses far exceed the irrigation requirements. Total water application usually exceeds 105 inches per year. The 10,900-acres of producing cranberry bogs utilize in excess of 95,000 acre-feet of water per year.

Lack of water for agricultural irrigation is not a problem in the region. Cranberry bog operators have removed many bogs from production, retaining those which had sufficient resources to raise the crop. In some instances, bogs have water shortages at certain periods of the year, which could be alleviated by better water management techniques. Operators are increasingly shifting to sprinkler irrigation systems to replace the older method of bog-flooding. Sprinkler irrigation requires a much lower volume of water than flooding. Another recent development has been the introduction of water-harvesting of berries which, although it uses water as opposed to the conventional cranberry rakes, results in a much higher percentage of the crop being harvested.

All in all, irrigation is not a problem area. The ongoing program of the Soil Conservation Service is assisting growers to install sprinkler irrigation systems, water-control structures, and other water management features. As a result, the topic of irrigation will not receive further consideration in this report.

5.8 FISH AND WILDLIFE

The Massachusetts Division of Fisheries and Wildlife manages fish and wildlife for their ecological, recreational, scientific, educational, and commercial values. These resources, thus, have importance for Massachusetts far beyond their intrinsic values and involve millions of people who are associated in one way or another with fish and wildlife. These numbers include the 3/4 million licensed and unlicensed hunters, fishermen, and trappers who depend directly upon the renewable animal resources of the state, as well as the thousands of others who are bait dealers, gun and tackle manufacturers, sporting goods distributors and retailers, fur buyers, licensing agents, law enforcement personnel, boat liverymen, gasoline station proprietors, and operators of tourist accomodations. A recent study showed that fish and wildlife-generated business was worth $110 million annually to the Bay State.

5.81 FISH

A. Introduction

The discussion of fishery resources in the Coastal Region will be confined to fresh water and the important fish species which utilize fresh water during their life cycle. Anadromous fish species (which move from salt water to fresh water to spawn) are among the outstanding fishery resources described in Section 5.81C.

In the Coastal Region, fish and fishing are sufficiently important that 60,000 licensees and perhaps another 100,000 unlicensed youngsters annually pursue recreational angling.

Table 5.23 provides summary information on the fresh water ponds, lakes, and reservoirs in the Coastal Region which are over 20 acres in size.

Both cold water and warm water fisheries are available, and the total acreage of those water bodies is 44,787. Cape Cod and the Islands provide by far the greatest acreage of cold water fishery in the region.

Table 5.24 summarizes information on the stream fisheries, providing mileages of cold water and warm water types in various parts of the region. Totals indicate approximately 408 miles of cold water fishery and approximately 142 miles of warm water fishery.

Access to the rivers, streams, ponds, lakes, and reservoirs varies from none, to locally-improved access, to full public access. The Public Access Board, under the Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles, uses a small portion of income from the state gasoline tax to acquire public access to great ponds and other waters in the state, and for trails for snowmobiling, hiking, and skiing. At its water access points, the board constructs launching ramps, canoe or small boat landings, parking areas, and approach roads.

The Public Access Board will continue to develop facilities throughout the state. The board's program concentrates on larger, more popular areas, so that greater numbers of people will benefit.

The Public Access Board has acquired access to waters in the coastal section of Massachusetts, shown in Table 5.25.

TABLE 5.23 - SUMMARY OF INVENTORY OF PONDS, LAKES AND RESERVOIRS 20 ACRES AND OVER IN SIZE[1/]

Item	Unit	Subregion			
		North-east	South-east	Cape Cod & Islands	Totals
Total Number of Ponds, etc.		88	220	122	430
Total Area	Ac	7,146	26,767	10,874	44,787
Cold Water Fisheries-Number		9	9	26	44
Cold Water Fisheries-Area	Ac	692	859	2,771	4,322
Warm Water Fisheries-Number		79	211	96	386
Warm Water Fisheries-Area	Ac	6,465	25,908	8,103	40,465

1/ Major Data Source: Inventory of the Ponds, Lakes and Reservoirs of various counties by James A. McCann et al., Water Resources Research Center, University of Massachusetts, Amherst, Massachusetts, 1972.

2/ See Appendix C for information concerning public water bodies.

TABLE 5.24 - SUMMARY OF STREAM FISHERIES[1/]

Subregion	Principal Fisheries Type: Cold Water (miles)	Principal Fisheries Type: Warm Water (miles)	Remarks
Northeast			
Ipswich - North Shore	133.2	2.2	
Mystic - Neponset	33.3	23.	
Subtotal - NE	166.5	25.2	
Southeast			
South Shore	62.	10.8	Coho salmon introduction program in Indian Head River.
Buzzards Bay	31.1	22.5	Mattapoisett River - best trout stream in study area.
Narragansett Bay	20.5	--	Palmer River - best trout stream in study area.
Taunton	91.3	83.8	Wading, Canoe and Winnetuxet Rivers - best trout streams in study area.
Subtotal - SE	204.9	117.1	
Cape Cod & Islands	36.4	--	"Salter" trout (sea run trout); Mashpee River and Scorton Creek - best trout streams in study area.
Total - Coastal Region	407.8	142.3	

1/ Data Source: SENE Study, Fish and Wildlife Single Purpose Reports, prepared by U.S. Fish and Wildlife Service, 1973-1974.

TABLE 5.25 - ACCESS ACQUIRED BY PUBLIC ACCESS BOARD

Water Body	Location	Area (acres)
Northeast:		
Boston Harbor	Lynn	TW[1/]
Boston Harbor	Winthrop	TW
Chebacco Lake	Hamilton	209
Danvers River	Salem	
Hood Pond	Ipswich	67
Horn Pond	Woburn	102
Ipswich River	Ipswich	TW
Little Mystic Channel	Boston	TW
Porter River	Danvers	TW
Rock Pond	Georgetown	57
Southeast:		
Back River	Weymouth	TW
Coles River	Swansea	TW
Falls Pond	North Attleborough	156
Lake Nippenicket	Bridgewater	354
Long Pond	Freetown	1721
Mattapoisett Bay	Mattapoisett	TW
Nasketucket Bay	Fairhaven	TW
New Bedford Harbor (Pease Park)	Fairhaven	TW
Sabbatia Lake	Taunton	237
South Watuppa Pond	Fall River	1283
Westport River	Westport	TW
Weweantic River	Wareham	TW
Apponagansett River	Dartmouth	TW
Green Harbor	Marshfield	TW
Long Pond	Plymouth	215
Little Long Pond	Plymouth	45
Cape Cod and Islands:		
Lagoon Pond (access to Vineyard Sound)	Tisbury	TW
Peters Pond	Sandwich	127
Scituate Harbor (Jericho Road)	Scituate	TW
Pamet River (access to Cape Cod Bay)	Truro	TW
Bass River (access to Nantucket Sound)	Yarmouth	TW
Lovells Pond	Barnstable	54
Shubael Pond	Barnstable	56
Cliff Pond	Brewster	193
Little Cliff Pond	Brewster	33
Sheep Pond	Brewster	142
Sesuit Harbor	Dennis	TW
Rock Harbor	Eastham	TW
Katama Point	Edgartown	TW
Ashumet Pond	Falmouth	203
Green Pond	Falmouth	TW
Saquatucket Harbor	Harwich	TW
Johns Pond	Maspee	317
Maspee-Wakeby Ponds	Maspee	729

1/ Tidewater.

B. Outstanding Fishery Resources

Anadromous Fishery

Anadromous fish important to sport and commercial fisheries of Massachusetts are the alewife (herring), the American shad, and the rainbow smelt.

The alewife is the most abundant anadromous fish in the state. Millions ascend coastal rivers and streams each spring to spawn in fresh water ponds and lakes. The adult fish return to salt water after spawning, and the young migrate to sea by autumn. Alewives, primarily plankton feeders, are valuable as forage for larger predatory fish. Alewives taken from the ocean are used in fish meal and for bait; fish netted on their spawning runs in fresh water are used for bait and for food.

The American shad is the largest member of the herring family. In the Coastal Region, only the North River in Scituate and the Palmer River in Rehoboth have substantial runs. Most adults return to sea after spawning; the young migrate to sea by fall. Shad feed mostly on plankton and are themselves prized as game fish.

Rainbow smelt are found along the entire coast of Massachusetts, where they travel a short distance up fresh water streams to spawn between March and mid-May. Smelt are caught with hook and line, mostly during fall and winter.

Major anadromous fish runs in the Coastal Region are, as follows:

Northeast
- Parker River - alewives

Southeast
- Back River, Weymouth - alewives
- North River - alewives, shad
- Jones River, Kingston - alewives, smelt
- Town Brook, Plymouth - alewives, smelt
- Agawam River, Wareham - alewives, smelt
- Nemasket River, Middleborough - alewives
- Palmer River, Rehoboth - shad

Cape Cod and Islands
- Herring River, Bourne - alewives
- Stony Brook, Brewster - alewives

The Division of Marine Fisheries exercises responsibility for approximately 100 anadromous fish runs in coastal rivers and streams. Fishways are constructed and maintained to pass upstream migrants around dams; and shad and smelt propogation are parts of the program.

North River - Experimental Coho Salmon Project

The North River in Plymouth County, together with its tributaries, supports runs of alewives and shad. A tributary, the Indianhead River, has been utilized since 1970 by the Division of Marine Fisheries for an experimental coho salmon project. Each spring, hatchery-reared smolts are released to migrate to sea, and each fall, returning 3-year-old fish are collected to obtain eggs for hatchery rearing. There is a modest sport fishery for the coho.

"Salter" Trout

"Salter" is the term applied to a trout which becomes sea-run. Populations of brook trout may become sea-run during their second year of life and re-enter fresh water periodically. Similarly, stocked brown trout in several Massachusetts coastal streams become sea-run. (The sea-run browns are the result of a Massachusetts Division of Fisheries and Wildlife (MDFW) program begun in 1973.) The browns grow faster and live longer than the brook trout. "Salter" trout are a potential trophy fish for sportsmen.

A 1973-1974 survey by MDFW established a list of 70 coastal streams believed to support sea-run trout. Based on that survey, four river systems were selected for intensive investigation because of their potential as habitat for sea-run trout: The Parker River in the northeast section; the Jones River in the southeast section; and on Cape Cod, Scorton Creek on the north shore and the southern Cape Cod system, a number of streams which flow into Nantucket Sound.

Nine streams are currently being stocked with sea-run brown trout. These streams are the Parker River, the Jones River, Beaverdam Brook in the southeastern section, and on Cape Cod, the Coonamessett, Child's, Quashnet, and Mashpee Rivers, Santuit Creek, and Scorton Creek.

Trout Fishery in Ponds on Cape Cod

Outstanding trout fishing is provided in a number of cold water ponds on Cape Cod. About one-third of the ponded waters over 40 acres in size are classified as cold water fishery. Those 16 ponds total 2,555 acres; 14 of the ponds are currently stocked with trout. Cliff Pond in Brewster has a particularly outstanding cold water fishery.

The water in the cold water ponds is groundwater exposed in kettle holes. The permeable sandy soils allow free circulation of water into and out of the ponds and that, in conjunction with the Cape's maritime climate, allows the water temperature to remain cool enough for trout throughout the summer. Other waters in the Coastal Region can support only put-and-take trout fisheries because the warm water temperatures in summer prevent carry-over from year to year.

Fishes Existing in Limited Numbers in Massachusetts Which Are Found in the Coastal Region

Eight species of fish found in the Coastal Region of Massachusetts are considered to exist in limited numbers in the state. Those fishes are shown in Table 5.26. Some species are more plentiful elsewhere.

5.82 WILDLIFE

A. Introduction

Despite the density of population in eastern Massachusetts, the Coastal Region provides habitat for a wide and interesting variety of wildlife species. The number of different ecological niches available for them to fill is related to the geographic location of the region and the physiographic variation within it. Ecosystem types range from upland forest to sand beach.

The location where different species occur in the region is determined in large part by the use to which the land is put and by the resulting vegetative cover. Tables in Section 5.82C present various land uses and cover types in the Coastal Region and plant animal species which are associated. Trends in land use in the region emphasize the importance of efforts to retain or improve what valuable wildlife habitat remains.

Some of the outstanding wildlife resources in the region are described briefly in Section 5.82D. Birds are a particularly outstanding resource; many interesting and uncommon species nest in the region or rest there during their migrations along the Atlantic flyway. Important wildlife areas, some publicly-owned and permanently preserved, others privately-owned and with questionable futures, provide habitat for both common and uncommon species. Protection of the habitats of those species so uncommon as to be designated "endangered" should receive high priority.

B. Value and Use of Wildlife Resources

The greatest value of wildlife species is that each species is a part of an ecosystem. Each has its role. Life depends on adequate functioning of the ecosystem, and knowledge of the interrelationships involved is still incomplete.

The secondary value of wildlife resources is its recreational use by the human population. Wildlife is used in both consumptive and nonconsumptive ways.

TABLE 5.26 - FISHES EXISTING IN LIMITED NUMBERS IN MASSACHUSETTS WHICH ARE FOUND IN THE COASTAL REGION

Species	Distribution	Status 1/
Swamp darter	Eastern coastal lowland ponds and streams	Uc
Fourspine stickleback	Marine or brackish coastal waters; sometimes ascends streams	U
Ninespine stickleback	Marine or brackish coastal waters; sometimes ascends streams	U
Threespine stickleback	Marine or brackish coastal waters; sometimes ascends streams	U
Longear sunfish	Introduced; reported from Palmer River, Rehoboth	Uc
Atlantic sturgeon	Ascends coastal streams in spring to spawn; may occur in Merrimack River (also Connecticut River)	T
Shortnose sturgeon	Possibly in coastal brackish waters	T*
Walleye	Assawompset, Long (Lakeville), Quittacas, Little Quittacas, and Picksha Ponds, Nemasket River; non-reproducing relicts of past stocking - approximately 20 years ago	Uc

1/ Uc - Uncommon
U - Status undetermined
T - Threatened

* Listed in Threatened Wildlife of the United States, March 1973, United States Department of the Interior, Fish and Wildlife Service, Resource Publication 114, U.S. Government Printing Office, Washington, D.C.

SOURCE: "An Inventory of Massachusetts Fish and Wildlife (Vertebrate) Resources" by P. S. Mugford, Massachusetts Division of Fisheries and Wildlife, Boston, Massachusetts, 1975.

Nonconsumptive recreational uses of wildlife resources include bird watching, nature study, and wildlife photography. These pursuits are especially popular in the Coastal Region where there is substantial interest in nature and the preservation of natural areas, and because there exist in the region outstanding locations for the observation of wildlife. Many have been permanently preserved as parks or refuges under governmental or private control.

Approximately 2.4 percent of the Massachusetts' population participates in hunting. A much smaller percentage engages in trapping. Harvestable wildlife species include white-tailed deer, snowshoe hare, cottontail rabbit, gray squirrel, opossum, raccoon, pheasant, bob-white, ruffed grouse, woodcock and waterfowl, all of which are hunted. In addition, the hunting, taking, or possession of house sparrow, starling, chipmunk, flying squirrel, and woodchuck is permitted when carried out lawfully. Beaver, muskrat, mink, weasel, otter, fox, raccoon, opossum, and bobcat may be trapped. Most of these species are found on Cape Cod, but there are no fox, bobcat, opossum, weasel, porcupine, or New England cottontail on either Martha's Vineyard or Nantucket. In addition, raccoon, muskrat, mink, otter, and skunk are absent from Nantucket.

The amount of hunting carried on in the Coastal Region is decreasing. In addition to declining habitat, population growth has caused many towns to prohibit or restrict hunting. (See Figure 5.16) Another strong factor involved has been the rise of anti-hunting sentiment. This is particularly strong in the Coastal Region.

Nevertheless, hunting remains a popular sport. Statewide hunter preference for various game species, in descending order of importance, with notes on habitat and stocking, are, as follows:[20]

Pheasant - agricultural land well interspersed with brushland, swamps, and small woodlots. Stocked annually to supplement wild population.

Deer - forested land in various stages of succession interspersed with swamps and openland. Deer are most numerous on Martha's Vineyard and Nantucket; over 100 are harvested from each island annually.

Ducks and Geese - coastal and inland wetlands, permanent open waters.

Ruffed Grouse - forest land in various stages of succession, well interspersed with old fields, orchards, and swamps.

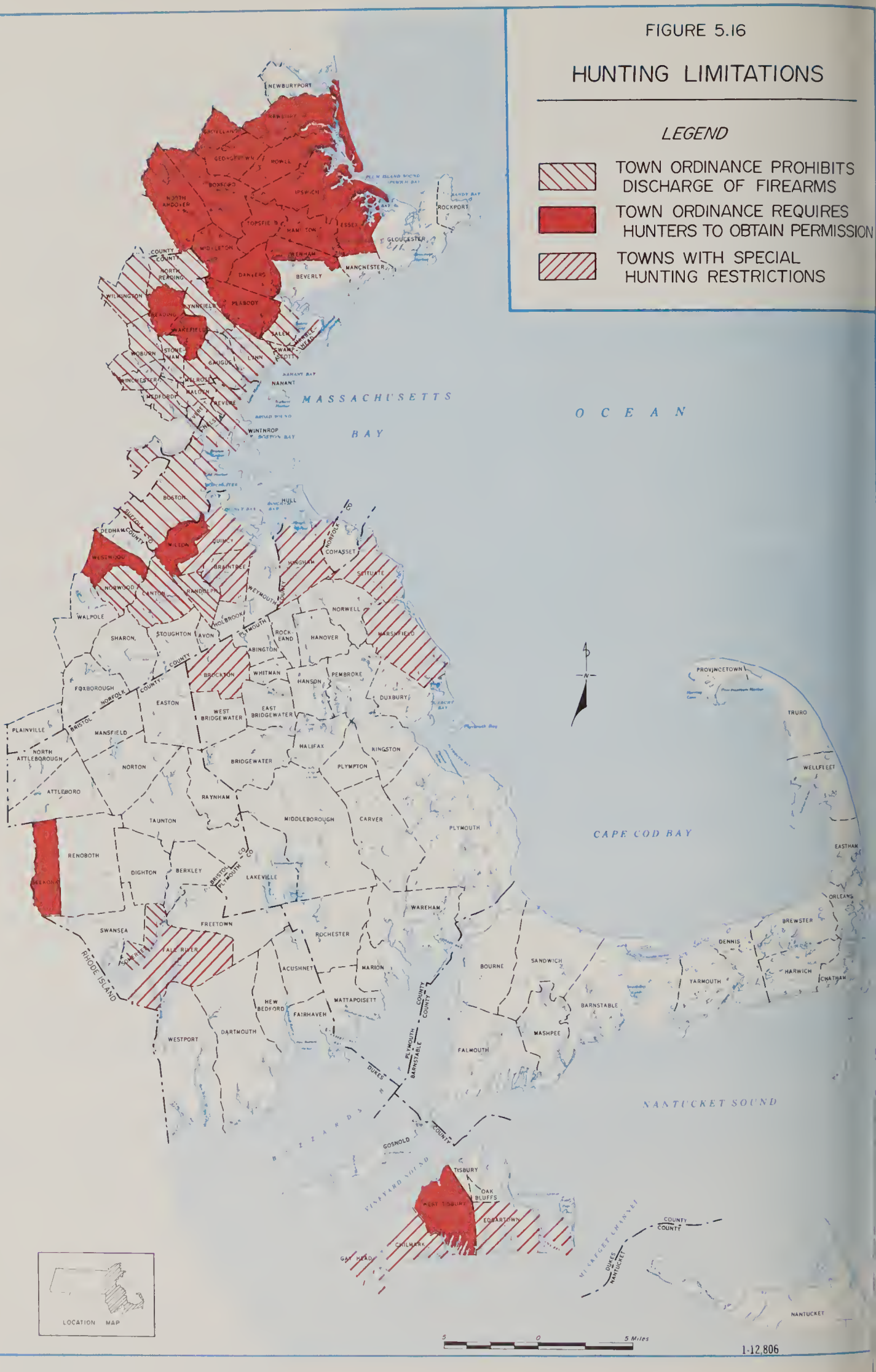
Cottontail Rabbit - agricultural land well interspersed with brushland, swamps, and small woodlots.

FIGURE 5.16

HUNTING LIMITATIONS

LEGEND

- TOWN ORDINANCE PROHIBITS DISCHARGE OF FIREARMS
- TOWN ORDINANCE REQUIRES HUNTERS TO OBTAIN PERMISSION
- TOWNS WITH SPECIAL HUNTING RESTRICTIONS



Woodcock - woodland areas containing much alder and aspen and fairly clear of heavy ground cover.

Gray Squirrel - hardwood forest containing mature oak and hickory trees.

Bob-white Quail - agricultural land well interspersed with brushland, swamps, and small woodlots. Quail can be hunted only in southeastern Massachusetts, on the Cape, and on the Islands. Two wildlife management areas are stocked.

Snowshoe hare are released annually by the Division of Fisheries and Wildlife in both Bristol and Plymouth Counties to supplement native populations. Irregular releases have occurred in Barnstable, Dukes, and Nantucket Counties, and small numbers of hare are known to be present in Barnstable and Nantucket Counties; possibly also on Martha's Vineyard.

Land Uses and Vegetative Cover

Wildlife populations in an area are intimately related to the land use and vegetative cover. Species have different needs for food, protective cover, and resting or nesting sites which must be satisfied by their habitats if the animals are to survive. Wildlife resources in the region include forest species, wetland species, and openland or agriculturally related species. There are also some species which can live in urban environments. Table 5.27 lists the vegetation and wildlife associated with the more important cover types in the region.

About 44 percent of the Coastal Region is upland forest. The forest wildlife habitat may be divided into three types: hardwood, softwood, and mixed hardwood and softwood. The forest stand, of whichever type, can vary in height and density and in associated understory and ground cover. Such differences affect the type and numbers of wildlife present.

Considered openland wildlife are those species which prefer open agricultural land or land which has recently been abandoned and is beginning to revert to woodland through natural plant succession. Almost 8 percent of the Coastal Region is in agriculture or abandoned agriculture.

Wetlands comprise about 13 percent of the Coastal Region. Of the different types of wetlands, wooded swamps cover the most area. Wooded swamps provide high value food and cover to woodcock, cottontail, hare, and deer and are important nesting and feeding areas to wood and black ducks when the swamp borders open water. The other types, in order of decreasing total area, with notes about their importance to wildlife, are, as follows:

Open Fresh Water--may produce aquatic vegetation of high value to waterfowl; provides food and cover for muskrat, beaver and otter, food for mink and raccoon.

TABLE 5.27 LAND COVER AND ASSOCIATED VEGETATION AND WILDLIFE

Land Cover Type	Approximate % of Land in Region	Vegetation Associated with Cover Type			Wildlife Associated with Cover Type		
		Trees	Understory	Plants	Mammals	Birds	Reptiles, Amphibians
Hardwood	18	scrub oak black cherry white oak red maple sugar maple red oak white ash white birch black locust American beech basswood quaking aspen	arrowwood wild raisin spice bush green brier witch hazel sarsaparilla		whitetail deer eastern cottontail gray fox shorttail weasel oppossum shorttail shrew hairy-tailed mole star-nosed mole raccoon eastern chipmunk gray squirrel striped skunk northern flying squirrel white-footed mouse woodland jumping mouse	ruffed grouse screech owl red-tailed hawk hairy woodpecker downy woodpecker yellow-bellied sapsucker blue jay common crow black-capped chickadee white breasted nuthatch red breasted nuthatch myrtle warbler scarlet tanager cardinal rufous-sided towhee slate-colored junco white-throated sparrow	spring peeper common garter snake northern black racer eastern milk snake American toad
Softwood	5	pitch pine white pine eastern hemlock other species often in plantations: scotch pine Norway spruce red pine white spruce	green brier honeysuckle		whitetail deer red squirrel	screech owl long-eared owl blue jay common crow black-capped chickadee slate-colored junco starling pine grosbeak	--
Mixed Hardwood and Softwood	21	scarlet oak black oak white pine eastern hemlock pitch pine American elm sugar maple red maple white ash American beech	arrowwood honeysuckle wild raisin spice bush green brier wild grape wintergreen shining clubmoss partridge-berry	sassafras witch hazel sarsaparilla salt spray rose	whitetail deer eastern cottontail gray fox raccoon striped skunk opossum shorttail shrew star-nosed mole hairy-tailed mole eastern chipmunk gray squirrel red squirrel northern flying squirrel white-footed mouse woodland jumping mouse	ruffed grouse long-eared owl red-tailed hawk yellow-bellied sapsucker hairy woodpecker downy woodpecker blue jay common crow black-capped chickadee white-breasted nuthatch red-breasted nuthatch myrtle warbler scarlet tanager rufous-sided towhee slate-colored junco white-throated sparrow northern oriole evening grosbeak	common garter snake northern black racer eastern milk snake American toad common newt spotted salamander

TABLE 5.27 - cont. LAND COVER AND ASSOCIATED VEGETATION AND WILDLIFE

Land Cover Type	Approximate % of Land in Region	Vegetation Associated with Cover Type		Wildlife Associated with Cover Type		
		Woody	Non-Woody	Mammals	Birds	Reptiles, Amphibians
Open Land (Agricultural Land)	5	Trees grown include: domestic fruit trees, ornamental trees and shrubs, Christmas trees	Crops and forage grown include silage corn, vegetable crops, alfalfa, grasses and cranberries in bogs	whitetail deer red fox shorttail shrew eastern chipmunk eastern cottontail woodchuck meadow vole striped skunk opossum	bobwhite ring-necked pheasant red-winged blackbird cowbird mourning dove common goldfinch starling	
Open Land (Abandoned Agricultural Land)	2	--	shedbush viburnum highbush blueberry juniper grasses	whitetail deer red fox shorttail shrew eastern chipmunk eastern cottontail meadow vole striped skunk woodchuck	bobwhite ring-necked pheasant red-winged blackbird cowbird mourning dove common goldfinch starling	
Heath	1	--	poverty grass beach plum lichens bearberry bayberry poison ivy reindeer moss beach heath	eastern cottontail	bobwhite ring-necked pheasant	
Sand	1	--	beach grass dusty miller beach pea poison ivy	--	common tern herring gull great black-backed gull	
Urban	18	ornamental trees	grasses ornamental herbs and shrubs	Norway rat house mouse gray squirrel shorttail shrew eastern mole	rock dove starling English sparrow nighthawk common grackle	
Power Lines	1	trees which do not interfere with primary land use	grass low shrubs		ruffed grouse rufous-sided towhee slate-colored junco	common garter snake northern black racer eastern milk snake American toad common newt spotted salamander

TABLE 5.27 LAND COVER AND ASSOCIATED VEGETATION AND WILDLIFE

Land Cover Type	Approximate % of Land in Region	Vegetation Associated with Cover Type			Wildlife Associated with Cover Type		
		Trees	Understory	Plants	Mammals	Birds	Reptiles, Amphibans
Wetland - Fresh Water	11	red maple black willow trembling aspen American elm	speckled alder grasses reeds sedges cattail silky dogwood witch hazel green brier	spice bush highbush blueberry arrowwood honeysuckle	muskrat mink raccoon star-nosed mole little brown myotis eastern pipistrel hoary bat otter beaver	woodcock tufted titmouse catbird cedar waxwing brown thrasher great blue heron eastern green heron kingfisher green-winged teal mallard duck black duck wood duck tree swallow	snapping turtle stinkpot spotted turtle wood turtle eastern box turtle eastern painted turtle eastern ribbon snake spotted salamander northern black racer red-backed salamander American toad spring peeper bullfrog pickerel frog wood frog gray tree frog
Wetland - Salt Water	2	--	cordgrass - salt meadow and salt marsh spike grass salt marsh bulrush black grass ditch reed		muskrat red fox striped skunk	black duck mallard duck great blue heron black crowned night heron osprey marsh hawk	northern diamondback terrapin

TABLE 5.27 - cont. LAND COVER AND ASSOCIATED VEGETATION AND WILDLIFE

Land Cover Type	Approximate % of Land in Region	Vegetation Associated with Cover Type		Wildlife Associated with Cover Type		
		Woody	Non-Woody	Mammals	Birds	Reptiles, Amphibians
Open Land (Agricultural Land)	5	Trees grown include: domestic fruit trees, ornamental trees and shrubs, Christmas trees	Crops and forage grown include silage corn, vegetable crops, alfalfa, grasses and cranberries in bogs	whitetail deer red fox shorttail shrew eastern chipmunk eastern cottontail woodchuck meadow vole striped skunk opossum	bobwhite ring-necked pheasant red-winged blackbird cowbird mourning dove common goldfinch starling	
Open Land (Abandoned Agricultural Land)	2	--	shedbush viburnum highbush blueberry juniper grasses	whitetail deer red fox shorttail shrew eastern chipmunk eastern cottontail meadow vole striped skunk woodchuck	bobwhite ring-necked pheasant red-winged blackbird cowbird mourning dove common goldfinch starling	
Heath	1	--	poverty grass beach plum lichens bearberry bayberry poison ivy reindeer moss beach heath	eastern cottontail	bobwhite ring-necked pheasant	
Sand	1	--	beach grass dusty miller beach pea poison ivy	--	common tern herring gull great black-backed gull	
Urban	18	ornamental trees	grasses ornamental herbs and shrubs	Norway rat house mouse gray squirrel shorttail shrew eastern mole	rock dove starling English sparrow nighthawk common grackle	
Power Lines	1	trees which do not interfere with primary land use	grass low shrubs		ruffed grouse rufous-sided towhee slate-colored junco	common garter snake northern black racer eastern milk snake American toad common newt spotted salamander

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Wetland - Salt Water	2	--	cordgrass - salt meadow and salt marsh spike grass salt marsh bulrush black grass ditch reed		muskrat red fox striped skunk	black duck mallard duck great blue heron black crowned night heron osprey marsh hawk	northern diamondback terrapin

Saltwater Wetland--provide food for wintering ducks, food and cover for muskrat, food for mink and raccoon.

Inland Shallow and Deep Marsh--shallow fresh marsh is a very important type, used by waterfowl for nesting and feeding; deep fresh marsh is the most important inland type - it is used for feeding and, in some cases, nesting by waterfowl; both types provide food and/or cover to muskrat, mink, and a variety of other species.

Shrub Swamps and Bogs--important to waterfowl when it borders permanent open water; shrub swamps provide high value food and cover to woodcock, cottontail, hare, and deer, food and/or cover to other species.

Seasonally Flooded Basins or Flats and Inland Fresh Meadows--seasonally flooded areas are utilized by waterfowl for feeding when flooded; fresh meadows are used as feeding grounds and for some nesting with favorable conditions. Both types provide food for deer during summer and fall, year-round food for fox, skunk, weasel, raccoon, and food and cover for pheasant.

Plants found in wetlands in the region vary widely, depending on the depth of water, period of flooding, or stage of plant succession.

Nearly all types of land or land uses support or allow some wildlife species. The greater the habitat diversity, the greater the diversity of wildlife species. Edge between field, forest, and wetland, as along a field or powerline, is extremely valuable to wildlife because it provides food and cover in close proximity.

Along with diversity, the extent of habitat is important. An area which would be ideal for a certain species may be useless to that species because civilization has made inroads and destroyed the continuity of the environment.

Large increases in urban uses have occurred while land area of agricultural or openland has declined significantly through conversion to urban uses or through natural succession to young forest. Young forest, which provides diversified habitat important to many kinds of wildlife, has become mature forest or has been converted to urban uses. These are continuing trends, and they imply continuing losses of wildlife habitat. Efforts to encourage the preservation of farmland and more active timber harvesting programs which would create openings (in which young forest would succeed) are two ways in which better wildlife habitat could be retained.

Heath is a unique vegetative type found primarily on Cape Cod, Martha's Vineyard, and Nantucket. The low, shrubby vegetation characteristic of heath supports a variety of openland wildlife species. The acreage of heath cover is dropping, as tree species invade and succession produces forest. Some abandoned agricultural land is permitted to succeed to heath, but the amount does not offset the trend. Management is necessary to prevent reversion of the heath to forest.

D. Outstanding Wildlife Resources

Waterfowl

The Coastal Region provides habitat to geese and ducks of many species, both residents and migrants. Of the marsh and pond ducks, the black duck and the mallard duck are common species; the former preferring salt water, the latter, fresh water. Both are Massachusetts' breeding birds. Some Canada geese also breed here and others use the wetlands and coastal waters during migration.

Many migrating species of waterfowl rest and feed in the Coastal Region because two eastern routes of the Atlantic flyway pass through in a north-south direction. Many species winter in the area, enabled to remain by the milder weather of the maritime climate. Species counted on the Massachusetts Division of Fisheries and Wildlife's annual winter inventory include (in order of decreasing numbers): eider, black duck, scaup, Canada Goose, goldeneye, scoter, bufflehead, merganser, and mallard. Thousands of eider are counted in Kingston and Duxbury Bays each winter. Wintering waterfowl number in the hundreds at many locations along the shore of the mainland and islands.

Colonial Waterbirds and Shore Birds

There are between 200 and 300 nesting colonies of waterbirds in the Coastal Region of Massachusetts. They are located mainly on the off-shore islands. Many, primarily gull and tern colonies, are located on Cape Cod; others are along the mainland.

A survey of colonial waterbirds[21/] conducted in 1976 by the Massachusetts Cooperative Wildlife Research Unit disclosed the numbers and species shown in Table 5.28. The numbers of breeding birds are shown to be declining. Among these are the Arctic, roseate, and common terns. Disturbance of their breeding habitat on the dunes is a major factor in the decline. Off-road vehicles are a particular menace. As a counter-measure, the Trustees of Reservations and the Massachusetts Audubon Society is carrying on a program of protecting tern nesting areas and monitoring reproductive success. The Cape Cod National Seashore also protects tern nesting areas within its boundaries.

Several long-legged waders more common to the south are increasing in numbers. Included are the great, snowy, and cattle egret and the glossy ibis.

Thousands of shore birds congregate at specific locations (thought to be chosen because of their rich invertebrate resources) each year to rest and feed during migration. The bird populations involved would suffer serious consequences if those sites should be lost to them. Important sites for stopping-over in the northeast are the Newburyport and Plum Islands area and Ipswich Beach; in the southeast, Snake Island in Boston Harbor, Third Cliff at Scituate, and the Plymouth Beach and Duxbury Beach area; on the Cape, the outer beaches from Monomoy to Eastham and marshes behind them all have large tidal flats attractive to shore birds.

TABLE 5.28 - COLONIAL WATERBIRDS OF THE MASSACHUSETTS COAST, 1976

Species	Approximate Number of Breeding Pairs	Status
Gulls		
Great black-backed	3,000	Relatively stable
Herring	30,000	Declining
Laughing	180	Continuing to decline
Terns		
Arctic	66	Continuing to decline*
Roseate	1,390	Continuing to decline*
Common	5,350	Declining*
Least	1,470	Stable
Double-crested cormorant	1,130	Increasing
Herons		
Black-crowned night	1,500	Declining
Little blue	10	Probably stable
Louisiana	3	Recent invader
Egrets		
Great	6	Slightly increasing
Snowy	600	Rapidly increasing
Cattle	10	Increasing
Glossy Ibis	75	Recent invader

* Procedures for acquiring "endangered" designation are being initiated.

Raptors

Two uncommon raptors, the peregrine falcon, considered endangered, and the American osprey, "status undetermined", may be seen in the Coastal Region. The American osprey breeds in the region. Its numbers were severely depleted by the effects of pesticides and loss of habitat in its

nesting areas. The best reproduction in the state is found near Westport in Bristol County. In 1976, 24 young were produced there from 11 nests. The birds have been moving into other areas in recent years, including: Wareham, Mashpee, Martha's Vineyard, and Naushon Island.

The peregrine falcon has also been a victim of pesticides. No longer a breeding species in Massachusetts, less than a dozen migrants can now be observed in the Coastal Region.

Song Birds

A great variety of song birds are found in the Coastal Region of Massachusetts as residents, migrants, or visitors. From 1966 to 1975, the Manomet Bird Observatory banded 146 species of song birds. Most numerous was the black-capped chickadee. The rare Ipswich sparrow is a winter resident of the Coastal Region. The great variety of bird species is related to the variety of habitat types available.

Threatened Species

Table 5.29 shows wildlife species which exist in limited numbers in Massachusetts and which are known to reside in or visit the Coastal Region. Two species, the Plymouth red-bellied turtle and the beach meadow vole, are known to exist only here. The red-bellied turtle, of which the Plymouth red-bellied turtle is a subspecies, has recently been nominated for review to determine whether it should be proposed for listing as an endangered or threatened species. Other listed species are found in greater numbers beyond Massachusetts.

Species presently threatened could eventually join the list of species extirpated from the Coastal Region, from the Commonwealth, or may become extinct. The following, once found in the region, are now extinct:

Heath hen--An eastern subspecies of the western prairie chicken, the heath hen is thought to have inhabited scrubby coastal plains from New Hampshire and probably southern Maine to Virginia and possibly the Carolinas. The last individual died on Martha's Vineyard in 1932.

Passenger pigeon--Once common, the last authentic records for Massachusetts indicate that a pair bred at Plymouth in 1889.

Great auk--The great auk was a penguin-like bird which occurred along the shore. Fragments of its bones have been found among the shell heaps at Ipswich.

Labrador duck--This was a winter visitor, already rare by the early 1800s. The last specimen taken in the state was shot at Swampscott in 1862.

TABLE 5.29

MASSACHUSETTS WILDLIFE SPECIES EXISTING IN LIMITED NUMBERS[1/] WHICH ARE FOUND IN THE COASTAL REGION

Species	Distribution	Estimated Numbers	Typical Habitat	Status[2/]
Mammals				
Moose	Occasional stragglers range into northeastern, central, and western parts of the state.	None resident. Regular stragglers.	Wilderness areas of early successional mixed stands interspersed with bogs and shallow ponds.	Peripheral
Gray seal	Muskeget and Tuckernut Islands, Nantucket County and adjacent waters.	12-18	In Massachusetts - shallow seas adjacent to sand bars and low islets.	Rare
Southern bog lemming	Plymouth County	Unknown	Bogs; dense swamps; cool, dense forest undergrowth.	Undetermined
Beach meadow vole	Known only Muskeget Island, Nantucket.	5,000-15,000	Sandy beaches overgrown with beach grass.	Rare
Birds				
American peregrine falcon	Coastal areas.	No breeders, migrants usually number less than a dozen annually.	Nests on high cliffs or ledges frequently overlooking water bodies or valleys.	Endangered
American osprey	Principally in Bristol, Barnstable, and Dukes Counties.	A few dozen in breeding season.	Isolated coastal or inland sites adjacent to sizeable bodies of water.	Undetermined
Laughing gull	Coastal, especially Cape Cod.	About 150-200 pairs in breeding population.	Salt meadows, shores of tidal creeks, grassy islets.	Undetermined
Common tern	Coastal beaches and islands, Plum Island south to Elizabeth Islands.	Fewer than 5,000 pairs.	Sandy beaches and island shores.	Undetermined
Artic tern	Outer Cape Cod and offshore islands.	Probably less than 50 pairs.	Rocky or sandy caostal and island beaches and shores.	Undetermined
Least tern	Coastal beaches from Essex County south to Bristol County	Probably less than 1,000 pairs.	Broad, flat, sandy beaches on mainland and coastal islands.	Undetermined
Short-eared owl	Nesting limited to coastal areas south to Cape Cod.	Unknown	Open plains, scrub flats, dunes, and marshes.	Undetermined
Eastern bluebird	Transient statewide, limited breeding.	Unknown	Open woods, swamps, rural roadsides, farmland, burnt over areas.	Undetermined

TABLE 5.29

MASSACHUSETTS WILDLIFE SPECIES EXISTING IN LIMITED NUMBERS[1/]
WHICH ARE FOUND IN THE COASTAL REGION

Species	Distribution	Estimated Numbers	Typical Habitat	Status[2/]
Reptiles				
Plymouth red-bellied turtle	Scattered ponds in Plymouth County, Naushon Island and possibly Ipswich.	Probably less than 200.	Quiet, shallow warmwater ponds.	Endangered
Northern diamondback terrapin	Buzzards Bay and Cape Cod Bay from Barnstable to Wellfleet.	Unknown	Salt marshes, tidal creeks, and estuaries.	Undetermined
Eastern box turtle	Statewide	Unknown	Fields, meadows, open woodlands, usually near water.	Undetermined
Timber rattlesnake	Blue Hills Reservation, Milton, Norfolk County and areas in western Massachusetts.	Unknown	Rocky fields, woodlands, and mountainsides.	Endangered
Northern copperhead	Blue Hills Reservation, Milton, Norfolk County and areas in western Massachusetts.	Unknown	Rocky, wooded hillsides, often moving to bottomlands during the summer.	Undetermined
Blue-spotted salamander	Recorded from various areas of Middlesex County; Springfield, Hampden County; a few Essex County towns; Attleboro, Bristol County.	Unknown	Lives underground in moist woodland.	Endangered
Spotted salamander	Statewide	Unknown	Lives underground in moist woodland.	Threatened
Marbled salamander	Principally Worcester County, with remnant colonies in Middlesex, Plymouth and Bristol Counties.	Unknown	Woodlands	Threatened
Four-toed salamander	Scattered from Connecticut River Valley eastward to Cape Cod.	Unknown	Swamps, sphagnum bogs, acidic meadows.	Undetermined

[1/] From Mugford, P.S., 1975. An Inventory of Massachusetts Fish and Wildlife (Vertebrate) Resources, Massachusetts Division of Fisheries and Wildlife, Boston.

[2/] Definition from Mugford, 1975, page 54:

Rare - Not immediately in peril and possibly stable at present, but existing in such low numbers or with such a restricted distribution that the entire species population could be seriously jeopardized by catastrophic events occurring within its range.

Endangered - In immediate danger of extinction or extirpation from the state due to critically low or drastically declining populations brought about by habitat modification, overexploitation, pollution, diseases, or other factors.

Undetermined - Not in immediate danger of extinction or extirpation, but showing signs of decline and causing justifiable concern; or being little known or apparently uncommon and possibly could be jeopardized by inadvertent actions. More information required to properly evaluate status.

Important Wildlife Areas

There are many areas within the Coastal Region which are of special importance to wildlife. A few of them are listed in Table 5.30. In addition to those in government ownership, Massachusetts is fortunate to have many areas preserved by such groups as the Trustees of Reservations, the Massachusetts Audubon Society, and community-based conservation trusts. Other areas, in private ownership, may or may not continue to serve the needs of wildlife as the human population grows and urbanization spreads.

5.9 RECREATION

The analysis of recreation supply, demand, needs, and alternatives has been limited to those outdoor recreation activities which are water-related or which are normally assumed to be enhanced or complimented by adjacent water bodies. These activities include swimming, camping, picnicking, canoeing and sailing, and hiking. The primary data source for recreation has been the 1976 Statewide Comprehensive Outdoor Recreation Plan (SCORP)[22/] prepared by the Massachusetts Department of Environmental Management. A basic data source for the SCORP was the "Inventory of Private Recreation" published by the National Association of Conservation Districts.

The available supply of recreation resources was obtained from adjusted figures for SCORP Regions IV (partial), V, VI, VII. The supply figures give a good indication of the extent of outdoor recreation available in the Coastal Region.

TABLE 5.31 - SUPPLY OF SELECTED RECREATION ACTIVITIES

Activity	Supply (1000 Activity Days)
Swimming	51,750
Camping	1,770
Picnicking	1,693
Canoeing - Sailing	4,428
Hiking	1,223

In addition to the recreation resources that can be quantified by the activity-days that they provide, the Coastal Region boasts a number of "landscape and natural areas" which provide a largely unquantified amount of passive recreation and enjoyment. These areas which have been identified in the 1974 Massachusetts Landscape and Natural Areas Survey include natural areas with unique scenic, historic or scientific significance. There are a total of 318 of these natural areas located in the region; of these, 172 sites are owned by governments, private conservation organizations, or institutions. One hundred and forty-six of the natural areas are wholly or partially owned by private individuals. Ownership of the natural areas is quite important in determining public access to enjoy the

TABLE 5.30 SOME IMPORTANT WILDLIFE AREAS 1/

Location	Type	Ownership/Management	Remarks
Northeast			
Northeast Wildlife Management Area, Newbury	Upland	State-Mass. Division of Fish & Wildlife, 1,453 acres	Pheasants, grouse, woodcock, ducks, deer, raccoon, cottontail rabbit, snowshoe hare, gray squirrel
Parker River - Plum Island Newbury, Rowley, Ipswich, Newburyport	Estuary - island	Federal-U.S. Fish & Wildlife Service - Parker River National Wildlife Refuge 6,417 acres State-Plum Island State Park, 76 acres & private	Many shorebirds, waterfowl nesting, nesting Pheasant, deer, bobolink nesting,
Mill Creek Wildlife Management Area, Newbury, Rowley	Upland & wetland	State-Mass. Division of Fish and Wildlife, 656 acres	waterfowl
Essex marshes, Essex	Coastal marshes, estuary	Private	Shorebirds, waterfowl nesting, nesting
Southeast			
Boston Harbor Islands	Islands	Administration by Mass. Dept. of Environmental Management and Metropolitan District Commission	Nesting of colonial waterbirds, including herons
Hockamock Swamp, Bridgewater	Inland wetland	Mass. Div. of Fisheries & Wildlife, 4,600 acres, and private	Deer, furbearers, waterfowl, especially migrants
Blue Hills Reservation	Upland	Metropolitan District Commission, 5,489 acres	Endangered timber rattlesnake, status undetermined, northern copperhead
Myles Standish State Park, Carver, Plymouth	Upland	State 12,461 acres	Deer, ruffed grouse, cottontail rabbit, bobwhite quail, bluebirds
Acushnet White Cedar Swamp, New Bedford	Inland wetland	1,800 acres state and local government, private organization, private	Wetland wilderness in urbanized area
Westport River	Estuary - islands	Island, Mass. Audubon, town	Osprey nesting (best reproduction in NE), also black-crowned night heron, green heron
North-South River, Scituate, Marshfield	Estuary	Local, government, private organizations, private	Bird nesting, snowy egrets
Clarks Island, Plymouth Harbor	Island	Private	Wading bird rookery
Rocky Gutter Wildlife Management Area, Middleborough	Inland wetland	State-Mass. Div. of Fish & Wildlife, 1,541 acres	Upland game, waterfowl
Cape Cod and Islands			
Otis Air Force Base, Mashpee	Upland	State, leased to military	Deer, ruffed grouse, woodchucks, bobwhite quail
Monomoy Island, Chatham	Island	U.S. Fish & Wildlife Service, 2,698 acres	Shorebirds, deer
Cape Cod National Seashore-Chatham, Provincetown, Orleans, Wellfleet, Truro	Coastal wetlands, Outer beaches, marshes	National Park Service, private	Shorebirds, bay and sea ducks
Muskeget & Tuckernuck Islands, Nantucket	Islands	Town (part of Muskeget Is.) and private	Rare gray seal and on Muskeget Island, rare beach meadow vole
Elizabeth Island, Gosnold	Islands	Private, except Penikese Island, 60 acres Mass. Div. of Fisheries & Wildlife	Deer, bird nesting, including heronry on Naushon Island relatively undeveloped

1/ Included are only a few of the more important wildlife areas in the Coastal Region. Some support unique species, but others provide habitat for more common species which have less habitat available to them with each passing year. Only those areas in public or quasi-public ownership will definitely continue to be important in the future. Their use cannot change.

resource. The vulnerability of the area to disruption and even possible loss through development is also dependent upon ownership and owner attitude. In some cases, the publicly owned areas are in jeopardy while some privately owned areas are safe and zealously protected by the owner.

Although not a natural resource, the region's many historic and cultural sites are an important factor in the total recreation picture. Days and weeks can be spent enjoying the tourist-oriented Freedom Trail in Boston, the Mayflower II in Plymouth, Mashpee Wampanoag Indian Museum, Plimouth Plantation, Provincetown Museum, the Whaling Museum in New Bedford, and numerous individual historic buildings harkening back to an earlier time. The region has nearly 250 properties listed in the National Register of Historic Places; of these, 71 have been designated as National Historic Landmarks. Cultural resources such as the Boston Symphony and Boston Pops Orchestra with world-wide fame add to the recreation supply.

Nearly half of the 35 rivers identified in the SCORP report as providing excellent potential for development as canoe trails are located in the Coastal Region. Table 5.32 indicates the portions of river identified for this purpose. The Wampanoag Sachems Canoe Passage has been designated along 72 miles of the North, Matfield, Satucket, and Taunton Rivers.

TABLE 5.32 - POTENTIAL CANOE TRAILS

River	Section of River
Ipswich River	Ipswich to Reading
Ten Mile River	Attleboro to Rhode Island
Wading River	Wrentham to Dighton
Town River	West Bridgewater to Bridgewater
Satucket-Matfield Rivers	East Bridgewater to Bridgewater
Nemasket River	Middleborough
Acushnet River	Acushnet
Mattapoisett River	Mattapoisett to Rochester
Weweantic River	Wareham
Wankinko River	Wareham
Agawam River	Wareham
Mashpee River	Cape Cod
Cotuit River	Cape Cod
Bass River	Cape Cod
Harwich River	Cape Cod
Herring River	Cape Cod
Sippican River	Rochester to Marion

The SCORP report also identifies several rivers which should be considered for protection under the Scenic and Recreational Rivers Act, Chapter 21, Section 17B of the General Laws. These rivers are included in Table 5.33.

TABLE 5.33 - POTENTIAL SCENIC AND RECREATIONAL RIVERS

River	Section of River
Taunton River	Paper Mill Village, Bridgewater to Route 44 bridge
North River	Entire river
South River	Entire river
Ipswich River	Middleton to mouth of river

There are more than 430 ponds and lakes, 20 acres and over in size, located within the region. These provide more than 44,000 acres of surface water resources. Surface water bodies are used for municipal water supply, fishing, fish and wildlife habitat, swimming, boating, as well as for visual contrast and aesthetic pleasure.

Access to freshwater bodies in the region is usually a function of their ownership and use. These reservoirs used for municipal water supply normally have restrictions upon public access and use. Swimming or wading is prohibited in all except supplementary, emergency supplies. Fishing and boating is also restricted, although there may be scattered instances of tightly-controlled reservoir fishing. Public access to the ponds, lakes, and reservoirs of the region is detailed in Appendix C prepared for the study by the Massachusetts Division of Water Resources.

The nearly 1,200 miles of saltwater shoreline do much to meet the outdoor recreation demand in the region and reduce the demand on freshwater recreation facilities. The SCORP study inventories nearly 75 miles of beachfront in the region. The beaches of Cape Cod and the Islands attract millions of users during the summer. The coastal resource also provides opportunity for much of the power boating enjoyed in the area.

Government provides numerous recreation opportunities throughout the region. The National Park Service is in the process of acquiring an additional 700 acres of land before 1980 to add to the Cape Cod National Seashore. Potential area within the authorized boundaries of The National Seashore includes over half of the "forearm" of Cape Cod. Another significant federal recreation resource is the development along the Cape Cod Canal maintained by the Army Corps of Engineers. The Canal complex provides fishing, hiking, and camping opportunities. The U.S. Fish and Wildlife Service manages three refuges in the region: the Monomoy National Wildlife Refuge at the "elbow" of Cape Cod, the Parker River National Wildlife Refuge (Plum Island) in Newbury and Rowley, and Nomansland Island off Martha's Vineyard.

The state government is the largest landholder of open space and recreation acreage in Massachusetts. The Division of the Department of Environmental Management most concerned with open space and recreation is Forests and Parks.

The Division of Fisheries and Wildlife in the Department of Fisheries, Wildlife and Recreation Vehicles is also concerned with water related recreation. The Metropolitan District Commission (MDC) which provides municipal water and sewerage service to much of the metropolitan Boston area also is responsible for parks and recreation in the same area.

The MDC manages over 11,000 acres for recreational enjoyment. The Trustees of Reservations are responsible for the management of nearly 4,500 acres of natural areas which are used extensively for passive recreation.

Town conservation commission land and town forests also serve to fill a need for passive recreation close to population centers.

Private lands which are open to the public for passive enjoyment are also important in the region. The Massachusetts Audubon Society controls nearly 4,000 acres of land which is managed for wildlife habitat and which also provides hiking trails and opportunities to observe and enjoy the natural beauty of the areas. The Audubon Society of Rhode Island controls Caratunk Refuge in Seekonk, Massachusetts.

Three major state recreation projects will be completed in the Coastal Region before 1990. These include the Boston Harbor Islands Park System. Sixteen of the 30 islands in Boston Harbor are already within the system. The Park will combine conservation and recreation based on a plan that emphasizes the unique, natural and man-made characteristics of these islands.

The Metropolitan Park System will involve expansion and further development of Boston's Franklin Park. A zoological garden with an all-weather African exhibit will provide the focus for the Park. The Neponset Reservation and Blue Hills Reservation may also be included in this development plan.

The South Cape Beach in the town of Mashpee is the third major park program slated for the region. Four hundred acres of land including marsh areas, two freshwater ponds, and about 2.5 miles of beachfront are included in the plans. The objectives are to expand public shorelines, as well as preserve a major conservation area within a developing region.

The undeveloped 450-acre Hawk's Nest State Park in Harwich offers potential for trails, camping, fishing, and swimming.

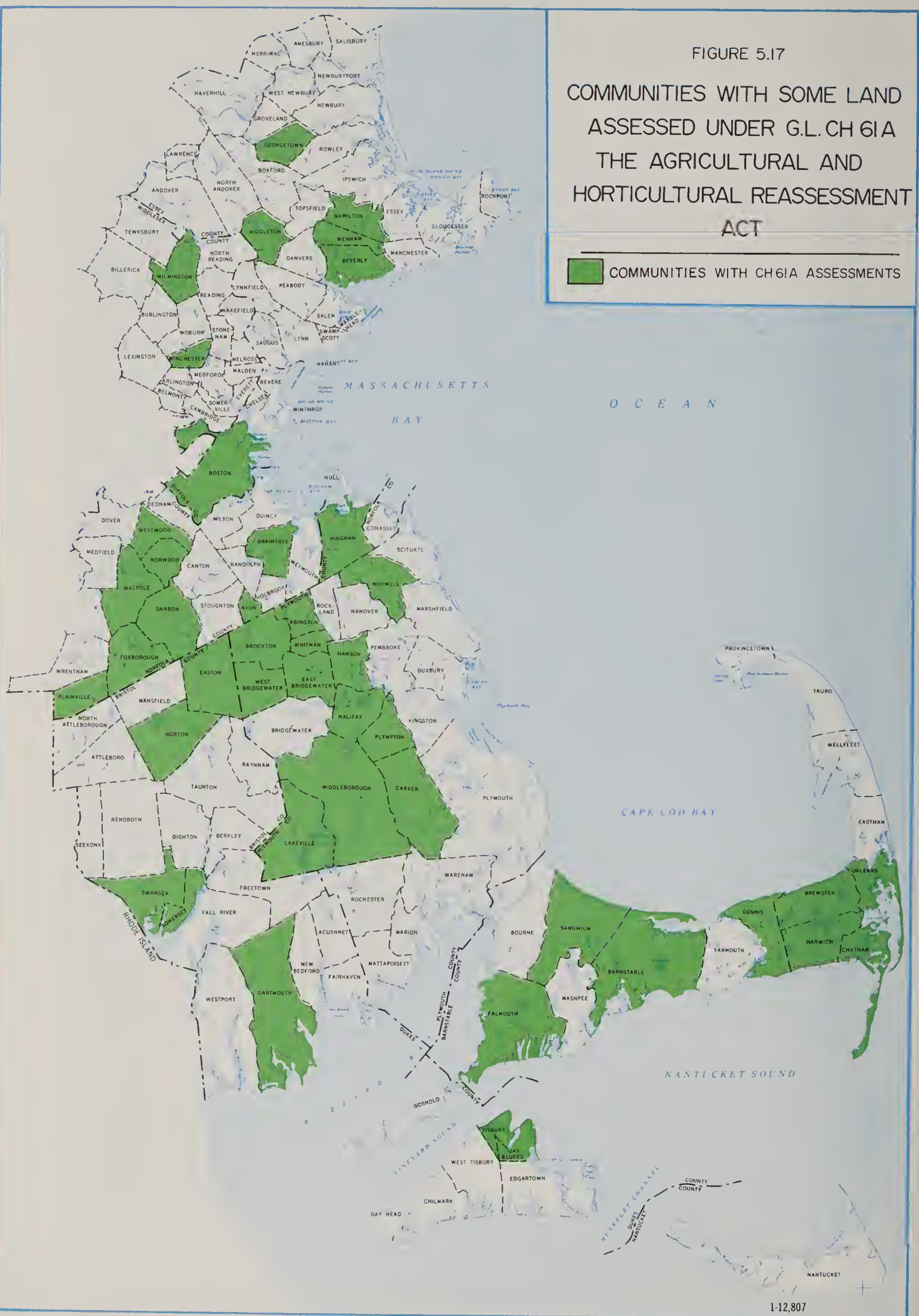
5.10 EXISTING PROGRAMS

Information on programs which affect the resources considered in this study are summarized in the following Tables and Figures.



Rockport, Massachusetts: For uncounted generations, the quaint fish houses at Rockport have been a basis study in composition for thousands of artists until they have become known as Motif No. 1. This quiet Cape Ann Community on the Bay State's North Shore has one of the oldest and best known summer art colonies, attracting students and experts from far and wide. Motif No. 1 was destroyed by a winter storm in 1978.

Subject	Agency	Law or Program
Land Use	Municipalities	Massachusetts General Laws, Chapter 61A, Sections 1-24 - The Agricultural and Horticultural Assessment Act. The act is designed to provide economic incentives in the form of lower property taxes to encourage maintenance of productive agricultural or horticultural pursuits. The act also has the effect of preserving open space. Massachusetts is one of 32 states that provide for such assessments. This act is sometimes referred to as the "Current Use Taxation of Farmland and Horticultural Land."
	Municipalities	Massachusetts General Laws, Chapter 184, Sections 23-33 - An act to protect conservation and preservation restrictions which are held by an appropriate public authority.
	Municipalities, Mass. Division of Forests and Parks	Massachusetts General Laws, Chapter 61, Sections 1-7 - The Classification and Taxation of Forest Lands (General Laws, Chapter 61) as amended. Landowners who have at least 10 contiguous acres of forest land having a value not over $400 an acre (land and timber) may apply to their local tax assessors to have their forest land classified under the law. If the state forester determines that the woodland owner qualifies, the land and timber are taxed separately. The land is assessed at not more than $10 per acre and annual taxes are paid on this basis. Also, a forest products tax of 8 percent is paid on the value of forest products harvested. A rollback applies if the land is withdrawn from the forest classification. In addition to the tax incentive program for private landowners there is a forest management program for public forest holdings.
	Soil Conservation Service, Conservation District, landowners	Conservation Operations Program - Proper land treatment is the basic concern of the Soil Conservation Service. This is the purpose of the Conservation Operations Program which provides technical assistance and advice on soil and water conservation to land users through local conservation districts. In the region, requests for assistance go to the Cape Cod, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, or Plymouth Conservation District which determines priorities for the Conservation Operations Program. The district is an arm of state government, having five unpaid supervisors whose job it is to consult with and advise the local SCS staff in scheduling their work load. Practices applied in the Conservation Operations Program include improved agronomic practices, measures to reduce soil erosion, practices designed to help carry water safely off sloping land, drainage improvements, and comprehensive measures to improve wildlife habitat and recreational areas.
	Farmers Home Administration, landowners	Soil and Water Loans - These loans are to facilitate improvement, protection, and proper use of farmland by providing adequate financing and supervisory assistance for soil conservation; water development, conservation and use; forestation; drainage of farmland; the establishment and improvement of permanent pasture; and related measure. Loans cannot exceed $100,000.
	U.S. Agricultural Stabilization and Conservation Service, landowners	The Agricultural Conservation Program (ACP), provides cost sharing assistance to farmers and other landowners who undertake soil, water, forest and wildlife conservation practices. The cost for such practices is shared between the federal government and the landowner. Technical assistance for ACP practices is rendered by the Soil Conservation Service, the Extension Service, and the U.S. Forest Service in cooperation with the Massachusetts Division of Forests and Parks.


FIGURE 5.17
COMMUNITIES WITH SOME LAND ASSESSED UNDER G.L. CH 61A THE AGRICULTURAL AND HORTICULTURAL REASSESSMENT ACT
COMMUNITIES WITH CH 61A ASSESSMENTS
MASSACHUSETTS BAY
OCEAN
CAPE COD BAY
NANTUCKET SOUND
RHODE ISLAND
AMESBURY
SALISBURY
MERRIMAC
NEWBURYPORT
HAVERHILL
WEST NEWBURY
NEWBURY
GROVELAND
GEORGETOWN
ROWLEY
LAWRENCE
BOXFORD
IPSWICH
ROCKPORT
ANDOVER
NORTH ANDOVER
TOPSFIELD
HAMILTON
ESSEX
GLOUCESTER
TEWKSBURY
MIDDLETON
WENHAM
MANCHESTER
BILLERICA
WILMINGTON
NORTH READING
DANVERS
BEVERLY
READING
LYNNFIELD
PEABODY
BURLINGTON
WAKEFIELD
SALEM
WOBURN
STONEHAM
SAUGUS
LYNN
SWAMPSCOTT
LEXINGTON
WINCHESTER
MELROSE
NAHANT
MEDFORD
MALDEN
ARLINGTON
REVERE
BELMONT
EVERETT
CHELSEA
SOMERVILLE
CAMBRIDGE
WINTHROP
BOSTON
NULL
DEDHAM
MILTON
QUINCY
DOVER
WESTWOOD
BRAINTREE
HINGHAM
CONASSET
MEDFIELD
NORWOOD
CANTON
RANDOLPH
SCITUATE
WALPOLE
HOLBROOK
NORWELL
SHARON
STOUGHTON
AVON
ROCKLAND
NANOVER
MARSHFIELD
ABINGTON
FOXBOROUGH
BROCKTON
WHITMAN
HANSON
PEMBROKE
WRENTHAM
EASTON
WEST BRIDGEWATER
EAST BRIDGEWATER
DUXBURY
PLAINVILLE
MANSFIELD
NORTH ATTLEBOROUGH
NORTON
BRIDGEWATER
HALIFAX
PLYMPTON
KINGSTON
ATTLEBORO
RAYNHAM
TAUNTON
MIDDLEBOROUGH
CARVER
PLYMOUTH
RENOBOTH
DIGHTON
BERKLEY
SEEKONK
LAKEVILLE
SWANSEA
FREETOWN
WARENAM
ROCHESTER
FALL RIVER
ACUSHNET
MARION
BOURNE
SANDWICH
NEW BEDFORD
FAIRHAVEN
MATTAPOISETT
WESTPORT
DARTMOUTH
FALMOUTH
MASHPEE
BARNSTABLE
YARMOUTH
DENNIS
BREWSTER
HARWICH
CHATHAM
ORLEANS
EASTHAM
WELLFLEET
TRURO
PROVINCETOWN
GOSNOLD
TISBURY
OAK BLUFFS
WEST TISBURY
EDGARTOWN
CHILMARK
GAY HEAD
NANTUCKET
1-12,807

Subject	Agency	Law or Program
Land Use	Municipalities	Zoning Enabling Act, Mass. General Laws Chapter 40A - The Act contains the basic authority for municipal zoning, predicated on the traditional police power concept of the promotion of health, safety, morals and general welfare. The Act authorizes municipalities to enact zoning laws designed among other purposes to lessen congestion in the streets, to conserve health; to secure safety from fire, panic and other dangers; provide adequate light and air; to prevent overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks and other public requirements; to conserve the value of land and buildings; to encourage the most appropriate use of land throughout the city or town; and to preserve and increase its amenities. Zoning may regulate and restrict the height, number of stories, and size of buildings and structures, the size of width of lots, the percentage of lot that may be occupied, the size of yards, courts and other open spaces, the density of population, and the location and use of buildings, structures and land for trade, industry, agriculture, residence or other purposes.
	Municipalities	Earth Removal-Mass. General Laws Chapter 40, Section 21 (17) and Chapter 40A, Section 2 - Municipal regulation of the extraction of removal of soil, sand, gravel, and other minerals was first carried on under the Zoning Enabling Act, which specifically authorizes municipalities to "regulate and restrict the...use of land...and (to) prohibit noxious trades within the municipality or any specified part thereof." The state legislature further empowered municipalities to enact nonzoning bylaws "prohibiting or regulating the removel of soil, loam, sand or gravel from land." In addition to exempting public land, the nonzoning bylaw must exempt earth removal which is part of site preparation for an approved subdivision or which is "the subject of a permit or license issued under the authority of the town." Because of these limitations, communities may and often do use both types of bylaws to ensure adequate coverage. Typically, such bylaws require a permit for earth removal and impose certain conditions upon the operation as a prerequisite to obtaining such a permit. Conditions may include, for example, control of drainage, maintenance of buffer zones along wetlands or public ways, screening and fencing, measures to reduce dust, limitation of the hours of operation; and grading, reloaming and reseeding after the work is done. Some eight municipalities have passed bylaws entirely prohibiting earth removal activities, except those absolutely necessary for preparation of a building site.
	Mass. Dept. of Agriculture	Agricultural Preservation - Chapter 780 of the Acts of 1977 allows the state to protect and encourage agriculture by the acquisition of agriculture preservation restrictions.

Subject	Agency	Law or Program
Land Use cont.	U.S. Soil Conservation Service, municipalities	Soil Survey - The SCS has the federal leadership for conducting the National Cooperative Soil Survey. In Massachusetts, the soil survey is carried on cooperatively with the Massachusetts Agricultural Experiment Station. Soil survey activities include the mapping, classification, correlation, and interpretation of soils according to national standards. The surveys are a basic scientific inventory of soil resources, based on soil properties. These surveys identify the kinds of soils, their extent, location and characteristics. Soil surveys play a vital part in planning by: 1. Providing a permanent inventory of the soil resources, 2. providing soil interpretations for various uses to guide planners at the local, regional, and state levels in making sound land use decisions for developing comprehensive plans, 3. providing data on the location of: a. wetlands, steep land, rocky land and areas with a high water table b. areas suitable for waste disposal c. areas that are suitable for use as residential, commercial, industrial, or school sites 4. providing many other soil interpretations that contribute to planning for a better quality environment. Many communities need, and want, soil survey information before the report is published in the usual manner. To provide this information ahead of the published report time, the SCS in Massachusetts prepares special soils reports for those communities which help pay for cost of preparation. A town soils report consists of a narrative description of each soil found within the community, copies of the soil survey mapping sheets and interpretative maps. These interpretative maps show the limitations of the soils for selected uses, such as sewage disposal, home sites or industrial sites. See Figure 5.16 for the status of the soil survey in the region.
	U.S. Soil Conservation Service, other USDA agencies, municipalities Conservation Districts	The Pilgrim Resource Conservation and Development Area - The Resource Conservation and Development (RC&D) Area is a locally initiated, sponsored and directed program which is planned to accelerate the conservation and development of natural resources; improve the general level of economic activity; and enhance the environment and standards of living. Each RC&D plan has its own unique goals. RC&D areas are sponsored by Conservation Districts and town and county governments, and may include municipalities, state agencies, comprehensive planning agencies and local nonprofit organizations.

FIGURE 5.18

STATUS OF SOIL SURVEYS

LEGEND

- SOIL MAPPING COMPLETED
- SPECIAL SOIL REPORT FOR COMMUNITY COMPLETED
- AREA PUBLISHED (NATIONAL COOPERATIVE SOIL SURVEY)
- MAPPING COMPLETE–PUBLICATION PENDING (NATIONAL COOPERATIVE SOIL SURVEY)



Subject	Agency	Law or Program
Land Use cont.	U.S. Soil Conservation Service, other USDA agencies municipalities, Conservation Districts cont.	The Pilgrim RC&D Area cover the southern half of the Coastal Region including Plymouth, Bristol, Barnstable, Dukes and Nantucket Counties. Goals of the plan include: 1. Completion of the Soil Survey and other natural resource inventories of the RC&D area and making this information accessible to planning boards and others charged with land use decisions. 2. Development of a watershed treatment and management program to minimize damages due to flooding, erosion, and sedimentation and to provide improved water storage for all purposes. 3. Development of a coastal zone improvement program including pollution abatement, proper land use, and erosion control. 4. Expansion of outdoor recreation areas to meet the needs of the people and protection, development, and management of historic sites, scenic vistas, and unique natural areas and tourist attractions. 5. Establishment of adequate sewage disposal systems, solid waste collection and disposal systems, adequate water supplies, and elimination of pollution and unsightly features to improve the general appearance of urban and rural areas. 6. Development of ample markets and marketing opportunities for wood and agricultural products and a quality vocational training program to develop needed skills. Expansion of the forestry program to promote urban-environmental forestry, forest wildlife habitat, recreation, aesthetics, high value timber species, and multiple use principles. 7. Development of a public education and information program to acquaint people with the RC&D program and to work with school officials in developing a school curriculum with conservation and environmental considerations. 8. Development of a close working relationship with planning agencies and governing officials for maximun effectiveness in coordinating programs, funding and technical expertise. Cost sharing is available through the RC&D program to assist sponsors with the installation of eligible measures.
	U.S. Soil Conservation Service Extension Service, Mass. Natural Resources agencies	Natural Resource Inventories - These studies identify and describe areas with natural resource development potential within the community. Each area is described and its alternative development potentials are listed in a report. Opportunities and problems in the use of each site or areas are identified and discussed. The Soil Conservation Service, County Regional Extension Service, Massachusetts Division of Forests and Parks, Massachusetts Division of Fisheries and Wildlife and other agencies conduct natural resource inventories for communities. A community wishing a natural resource inventory requests help from the Conservation District which, in turn, arranges for the inventory. Status of the Natural Resources Inventory Program is shown on Figure 5.19.

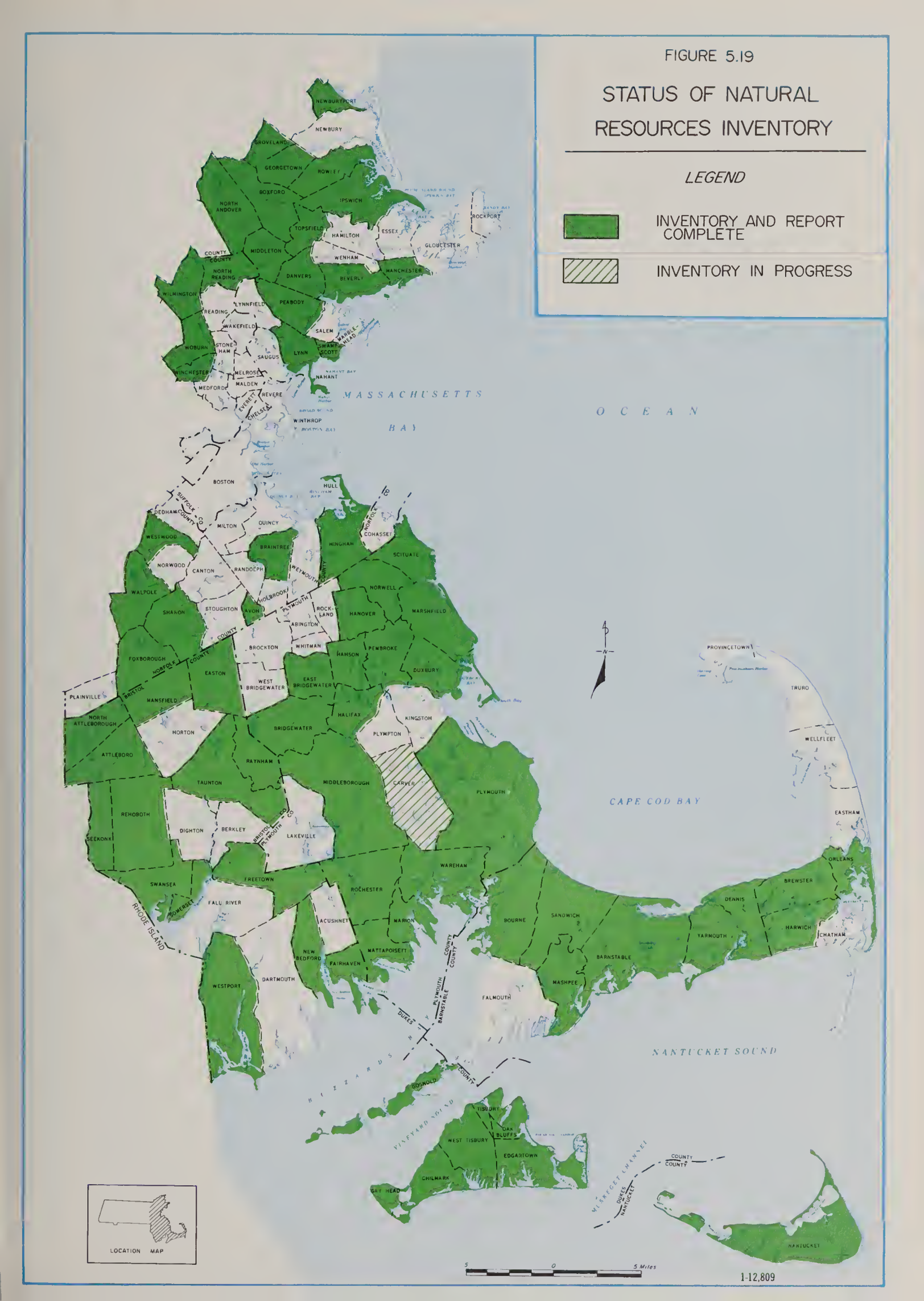
FIGURE 5.19

STATUS OF NATURAL RESOURCES INVENTORY

LEGEND

INVENTORY AND REPORT COMPLETE

INVENTORY IN PROGRESS


NEWBURYPORT
NEWBURY
GROVELAND
GEORGETOWN
ROWLEY
BOXFORD
IPSWICH
NORTH ANDOVER
ROCKPORT
TOPSFIELD
HAMILTON
ESSEX
GLOUCESTER
MIDDLETON
WENHAM
MANCHESTER
NORTH READING
DANVERS
BEVERLY
WILMINGTON
LYNNFIELD
PEABODY
READING
WAKEFIELD
SALEM
WOBURN
STONEHAM
SAUGUS
LYNN
SWAMPSCOTT
MARBLEHEAD
WINCHESTER
MELROSE
NAHANT
MEDFORD
MALDEN
REVERE
EVERETT
CHELSEA
WINTHROP
MASSACHUSETTS BAY
OCEAN
BOSTON
HULL
DEDHAM
MILTON
QUINCY
COHASSET
WESTWOOD
BRAINTREE
HINGHAM
SCITUATE
NORWOOD
CANTON
RANDOLPH
WEYMOUTH
NORWELL
WALPOLE
HOLBROOK
PLYMOUTH
ROCKLAND
HANOVER
MARSHFIELD
SHARON
STOUGHTON
AVON
ABINGTON
BROCKTON
WHITMAN
HANSON
PEMBROKE
DUXBURY
FOXBOROUGH
EASTON
WEST BRIDGEWATER
EAST BRIDGEWATER
PLAINVILLE
MANSFIELD
HALIFAX
KINGSTON
NORTH ATTLEBOROUGH
HORTON
BRIDGEWATER
PLYMPTON
ATTLEBORO
RAYNHAM
TAUNTON
MIDDLEBOROUGH
CARVER
PLYMOUTH
REHOBOTH
DIGHTON
BERKLEY
LAKEVILLE
SEEKONK
WAREHAM
SWANSEA
FREETOWN
ROCHESTER
FALL RIVER
SOMERSET
ACUSHNET
MARION
BOURNE
SANDWICH
NEW BEDFORD
MATTAPOISETT
FAIRHAVEN
WESTPORT
DARTMOUTH
FALMOUTH
MASHPEE
BARNSTABLE
YARMOUTH
DENNIS
HARWICH
CHATHAM
BREWSTER
ORLEANS
EASTHAM
WELLFLEET
TRURO
PROVINCETOWN
CAPE COD BAY
NANTUCKET SOUND
RHODE ISLAND
COUNTY
COUNTY
COUNTY

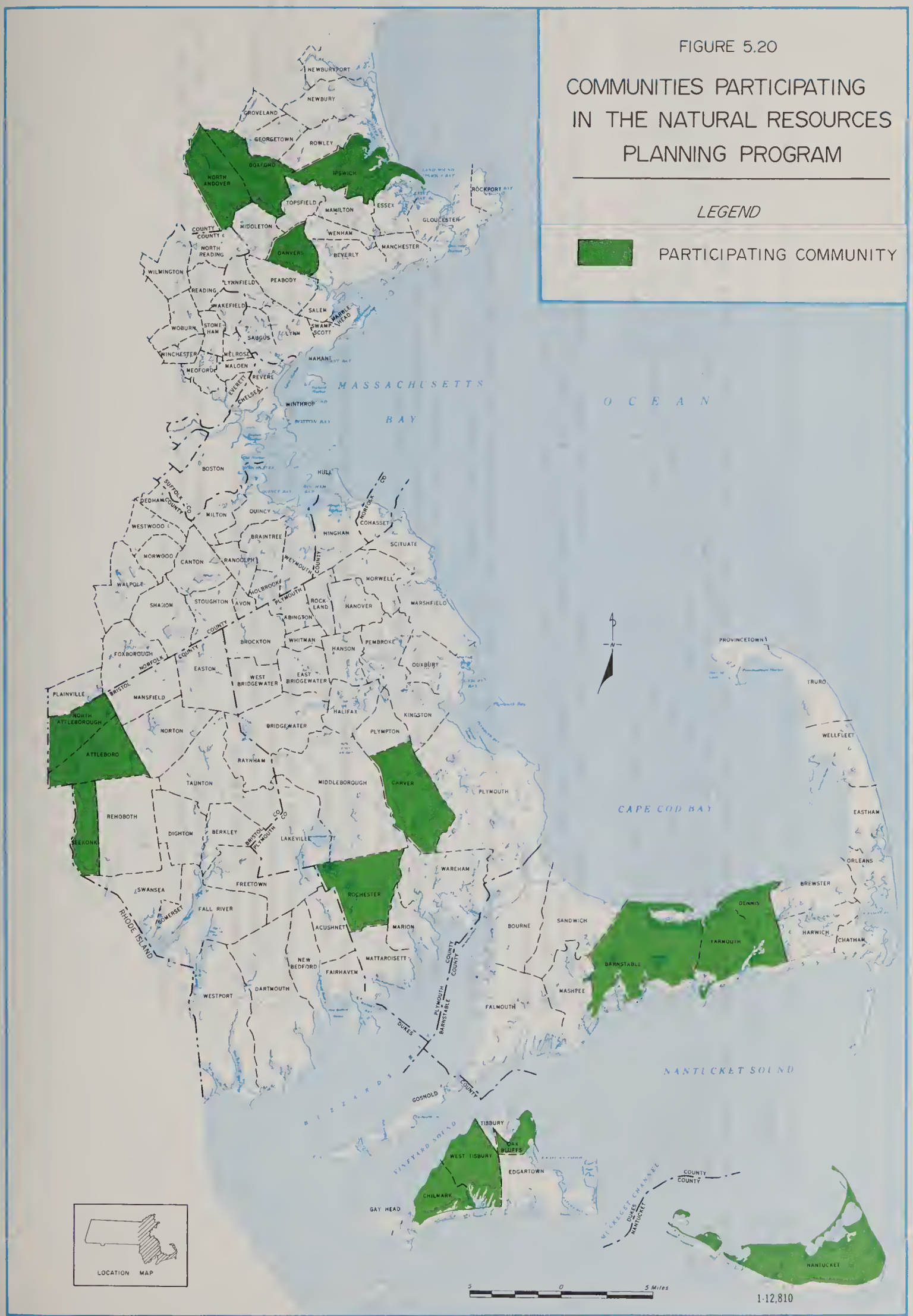
Subject	Agency	Law or Program
Land Use cont.	U.S. Soil Conservation Service, Extension Service, Mass. Division of Forests and Parks, Mass. Division of Fisheries and Wildlife, Conservation Districts, municipalities	Natural Resources Planning Program - The NRPP provides for local communities to inventory their present natural resources, to rate those resources against standards and criteria, to determine the consequences of proposed actions on natural resource base, and to plan the most acceptable future course of action to maintain or improve the community's level of environmental quality. The Natural Resources Planning Program: 1. Gives citizens the major role, with local people doing most of the work, making all the decisions, and implementing any needed changes in community policies to meet their goals. 2. Closely relates the community's natural resources base to numbers of people the natural resources can safely support. 3. Provides help from regional technical teams that represent many agencies and disciplines. The teams are composed of personnel from the Soil Conservation Service, Cooperative Extension Service, Massachusetts Division of Fisheries and Wildlife, and Massachusetts Division of Forests and Parks. Other state and federal agencies assist as requested. The Conservation District accepts applications from communities requesting the program, screens the applications, establishes priorities for assistance by the technical teams, and coordinates agency assistance to the selected communities. 4. Includes standards and criteria for rating the resource base. 5. Is "open ended": Local citizens can continually monitor their area's natural resource condition and update land use plans as needed. One of the most important aspects of the program is its emphasis on citizen involvement. Local citizens provide the personnel to: (1) inventory, in detail, the present natural resources of their community (2) rate these natural resources against existing standards and criteria (3) identify problem areas (4) assess alternative courses of action (5) prepare a definite plan of action and then, (6) implement planned measures to maintain or enhance their natural resources to achieve the community's selected level of environmental quality. Whatever course of action a community chooses, through use of the program, the community will know in advance the likely consequences of those actions on the natural resource base. Coastal Region communities participating in the Program are indicated in Figure 5.20.
	Farmers Home Administration, RC&D sponsors	Resource Conservation and Development Loans - These loans are to assist sponsoring public agencies in Resource Conservation and Development (RC&D) Areas. Loan funds may be used for (1) rural community public outdoor-oriented water-based recreational facilities; (2) soil and water, development, conservation control and use facilities; (3) community water storage facilities. Loans cannot exceed $250,000.

FIGURE 5.20

COMMUNITIES PARTICIPATING IN THE NATURAL RESOURCES PLANNING PROGRAM

LEGEND

PARTICIPATING COMMUNITY



1-12,810

EXISTING PROGRAMS

Subject	Agency	Law or Program
Land Use Forestland	U.S. Forest Service, Mass. Division of Forests and Parks, landowners	Renewable Resources Program - The Forest Resources Planning Act of 1974 provides for long-term planning for the management, protection and utilization of all renewable resources on forestland. The Forest Service and the Massachusetts Department of Environmental Management, Division of Forests and Parks, cooperatively conduct forestry programs on state and privately owned forestland. The forest resources of the Central Region also benefit from research in various aspects of forestry conducted at 80 different laboratories and other scientific facilities. These activities are grouped into five systems: recreation, wildlife, timberland and water, human and community development. Recreation System - The goal of this system is to increase the supply of outdoor recreation opportunities and services through programs which emphasize dispersed recreation. Assistance is given private forest landowners who are interested in helping provide public recreation opportunities, or integrate multiple uses into their forest management programs. Research is conducted to strengthen technology and understanding of recreation demands, trends, values and environmental impacts, as well as quantify and rank commodity and amenity values. Wildlife System - This system provides for increased use and enjoyment of wildlife while increasing both the diversity and numbers of fauna and the protection of threatened and endangered species. Technical assistance and financial incentives encourage nonindustrial private forest landowners to include habitat protection and development among their own management objectives. Research emphasizes habitat identification and improvement for endangered species and the impact of alternative forest practices on game and nongame habitats and populations. Timber System - The goal for the timber system is to increase timber supplies and quality to the point where benefits are commensurate with costs. Opportunities to increase timber supply exist on small private holdings, as well as, on Massachusetts state-owned forest areas. The program provides incentives for private timber landowners to grow commercial timber and for improved use of the trees and logs that are harvested. Major research includes better utilization of timber; improving the rates of timber growth and yield, improving the protection for forests from wildfire, insects and diseases; and proving better inventory and evaluation of resources.

Subject	Agency	Law or Program
Land Use Forest-land cont.	U.S. Forest Service, Mass. Division of Forests and Parks, landowners cont.	Land and Water System - The land and water system is an aggregation of many basic stewardship and land treatment activities to meet minimum air and water quality standards. This system permits control of man-caused erosion on state and private forest lands through technical assistance and program support. Important areas of research include the nature and extent of nonpoint sources of pollution, improved logging practices for fragile soils and steep slopes, and improved efficiency of fire prevention and firefighting operations. Human and Community Development System - This system is concerned with the relationships between man and his forest environment. All renewable resource programs are focused to increase goods and services from forest land; this means serving employment, housing and other social needs. Assistance to communities is provided for urban and community forestry, rural community fire protection and land use planning. Conservation education and manpower training programs are designed to enhance the knowledge and skills of rural residents.
	U.S. Agricultural Stabilization and Conservation Service, landowners	The forest Incentives Program (FIP) provides cost-sharing assistance to landowners who undertake forestry conservation practices. Program objectives are to increase the production of timber and wood products to reduce and abate pollution of streams and other bodies of water by planting trees in disturbed areas and to benefit communities by providing wildlife and landscape beauty and increasing outdoor recreation opportunities. The cost for such practices is shared between the federal government and the landowner. Technical assistance is provided by the SCS and the Forest Service in cooperation with the Massachusetts Division of Forests and Parks.
	Mass. Natural Resource Agencies	The Massachusetts Department of Environmental Management and the Massachusetts Department of Fisheries, Wildlife and Recreational Vehicles are applying multiple-use management to approximately 35,000 acres of forest land under their jurisdiction as authorized under General Law 132, Section 31, and General Law 131, Section 6.

Subject	Agency	Law or Program
Flooding	U.S. Soil Conservation Service, state and local governments U.S. Forest Service	Public Law 83-566, The Small Watershed Protection and Flood Prevention Program - PL-566 provides federal technical, and financial assistance to states, local communities, conservation districts, and other groups in solving their land and water problems. Project purposes which may be included in a PL-566 watershed plan include: conservation land treatment, flood prevention, agricultural water management, industrial and municipal water supply, recreation and fish and wildlife. Flood prevention must be a major concern in each project. PL-566 watersheds are limited to 250,000 acres in size. The program applies to land and water resource problems which cannot be solved by individual landowners on their own property. The PL-566 watershed program helps improve the quality of the natural resource base, the quality of the environment and the quality of the standard of living by: 1. reducing erosion and sedimentation through the application of land treatment practices, 2. identifying flood hazard areas for flood plain management measures, 3. promoting proper land use and management, 4. improving agricultural water management practices, 5. providing multiple purpose reservoirs for recreation, fish and wildlife, and water supply, 6. reducing flood damages, hazards to life and health, and the inconvenience caused by flooding. In the Coastal Region, eight watersheds are, or have been, involved in the PL-566 program. See Figure 5.20 for location of these watersheds. The Little River in Newbury and Newburyport was authorized for Work Plan preparation in 1963. A preliminary investigation found that a PL-566 project would be feasible to provide flood protection to agricultural land and water-based recreation. The agricultural land was later taken out of production and promoted as an industrial park. In 1969, the mayor of Newburyport was in opposition to use of one of the dam sites for flood control purposes. In view of the changed conditions and lack of local support, planning assistance to the watershed was terminated. An application for planning assistance for the Ipswich River Watershed covering 86,000 acres was submitted in 1963. Watershed problems included flooding of residences and commercial business, municipal water supply, and a lack of water-based recreation. Preliminary investigations showed flooding of cellars to be a combination of high groundwater levels and overland flooding. Filling of wetlands and loss of natural flood storage was also a problem. The Water Resources Commission prepared an independent study of the water supply situation which ultimately recommended a pumped storage site in Ipswich. Local interest in developing a flood control project in the watershed was not strong and the project is now in an inactive status.

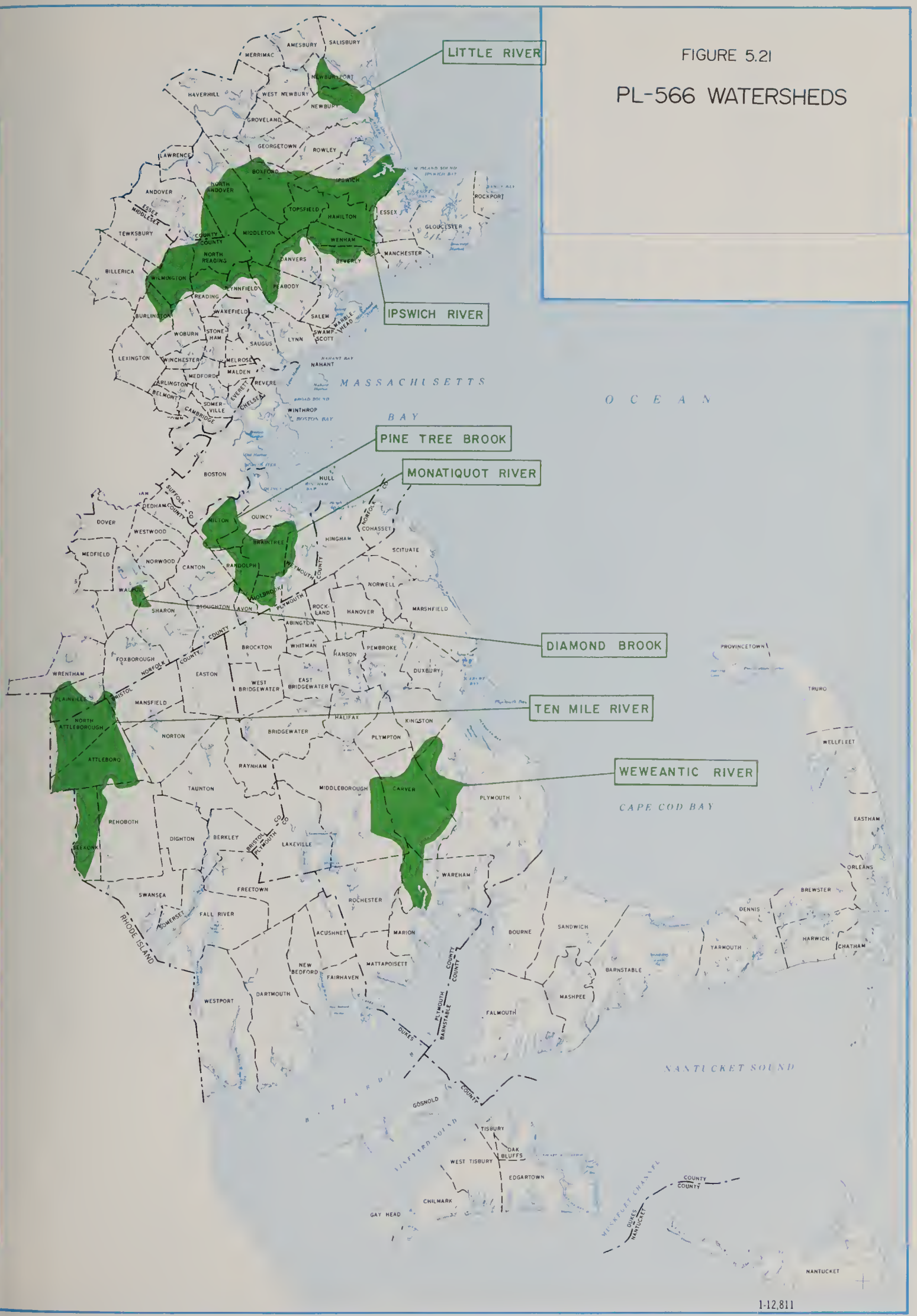


FIGURE 5.21

PL-566 WATERSHEDS

1-12,811

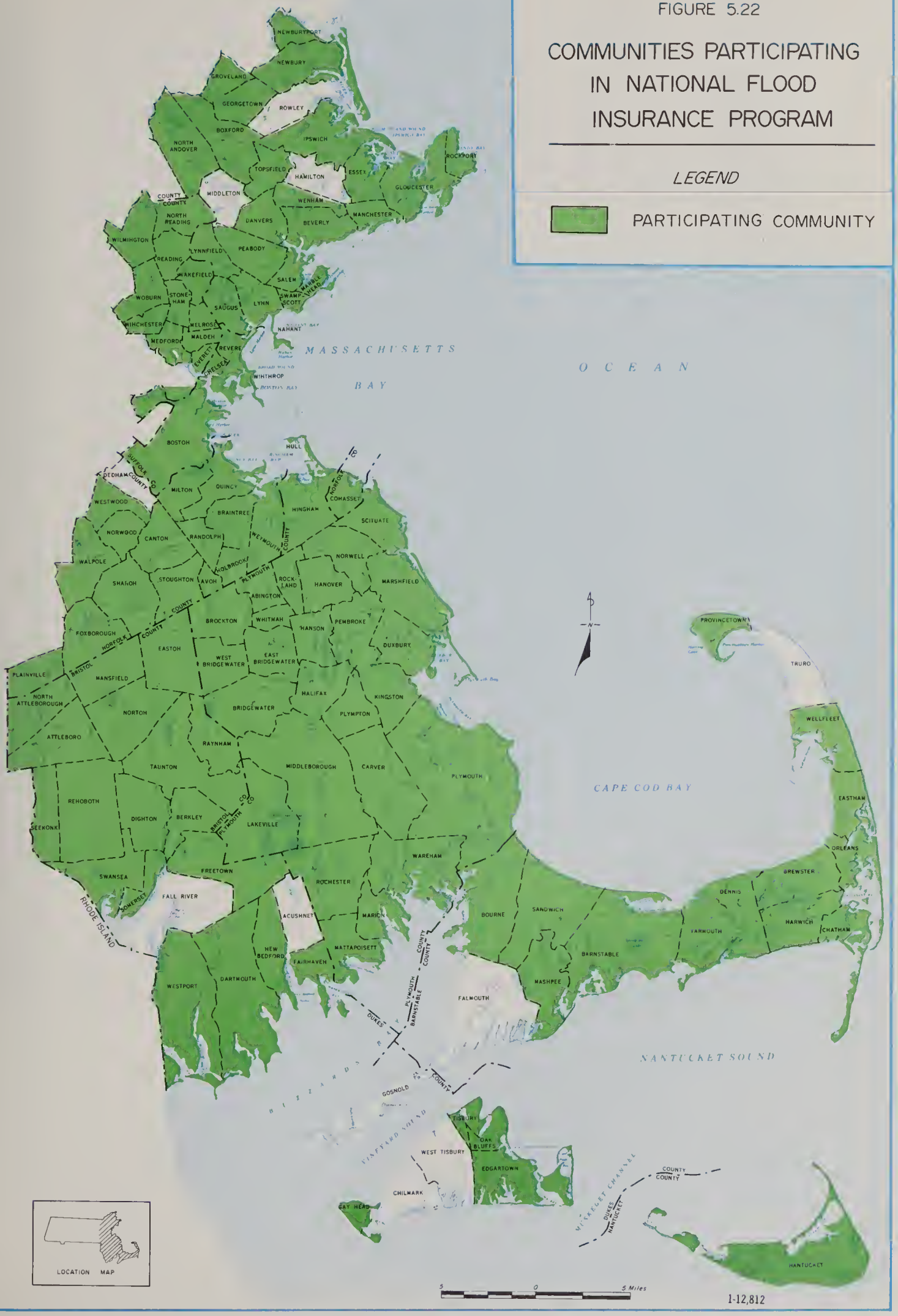
Subject	Agency	Law or Program
Flooding cont.	U.S. Soil Conservation Service, state and local governments, U.S. Forest Service cont.	The Pine Tree Brook Watershed in Milton, Massachusetts is the only completed PL-566 project in the Coastal Region. Flood protection for an urban area of Milton is provided by conservation land treatment and a multiple-purpose wildlife habitat and floodwater retarding structure. The dam controls about 53 percent of the Pine Tree Brook Watershed. Project sponsors include the town of Milton and the Norfolk Conservation District. The Diamond Brook Watershed in Walpole, Massachusetts has recently been approved for installation. Measures include land treatment, a multiple-purpose flood water retarding and fish and wildlife structure, channel enlargement, and an enlarged floodwater conduit under the center of Walpole. The project will provide an estimated 99 percent reduction in average annual floodwater damages on Diamond Brook. A 17-acre pool which will support a warm water fishery and wetland wildlife will be provided by the multiple-purpose dam. Sponsors of the project are the town of Walpole and the Norfolk Conservation District. The Weweantic River Watershed was the subject of a Reconnaissance Investigation Report in 1971. Primary watershed problems are related to water management for efficient production of cranberries. Floodwater problems in some years are contrasted with a lack of water for irrigating and water-harvesting in other years. The Reconnaissance Report concluded that a PL-566 project could be effective in providing flood protection as well as water storage for cranberry culture. Local participation in the project was contingent upon creation of a watershed association with powers to tax growers, acquire land rights, and manage water resources. Local support for the project and the watershed association was not forthcoming and planning for the project is in an inactive status. The Ten Mile Watershed in northwest Bristol County was approved for planning assistance in 1973. Flooding is a major problem in the downtown areas of Attleboro and North Attleborough. Detailed studies of hydrology and hydraulics are now underway in conjunction with Flood Insurance Studies in Attleboro, North Attleborough, and Seekonk.
	U.S. Department of HUD and municipalities	National Flood Insurance Program - As of July 1977 all but ten towns in the region had joined the National Flood Insurance Program, and property owners can now purchase low cost flood insurance protection. In return for this federally-subsidized insurance, the towns are required to consider flood hazards before issuing building permits, subdivision approvals, or zoning variances. After detailed hydrologic and hydraulic studies are made, HUD will issue flood zone maps which accurately delineate the flood hazard area and depth of flooding. Local governments must then require all new construction be above the 100-year flood elevation. Most financial institutions must require that flood insurance be purchased on any property within the flood hazard zone on which mortgages are accepted. As a condition of participation in the National Flood Insurance Program, a community must adopt flood plain management regulations meeting minimum standards published by the Federal Insurance Administration. A community must: (1) require building permits for all new construction and substantial improvements and (2) review the permit to assure that sites are reasonable free from flooding. For its flood prone areas. the community must also require: (1) proper anchoring of structures, (2) the use of construction materials and methods that will minimize flood damage, (3) adequate drainage for new subdivisions, and (4) that new or replacement utility systems be located and designed to preclude flood loss.

FIGURE 5.22

COMMUNITIES PARTICIPATING IN NATIONAL FLOOD INSURANCE PROGRAM

LEGEND

PARTICIPATING COMMUNITY



1-12,812

EXISTING PROGRAMS

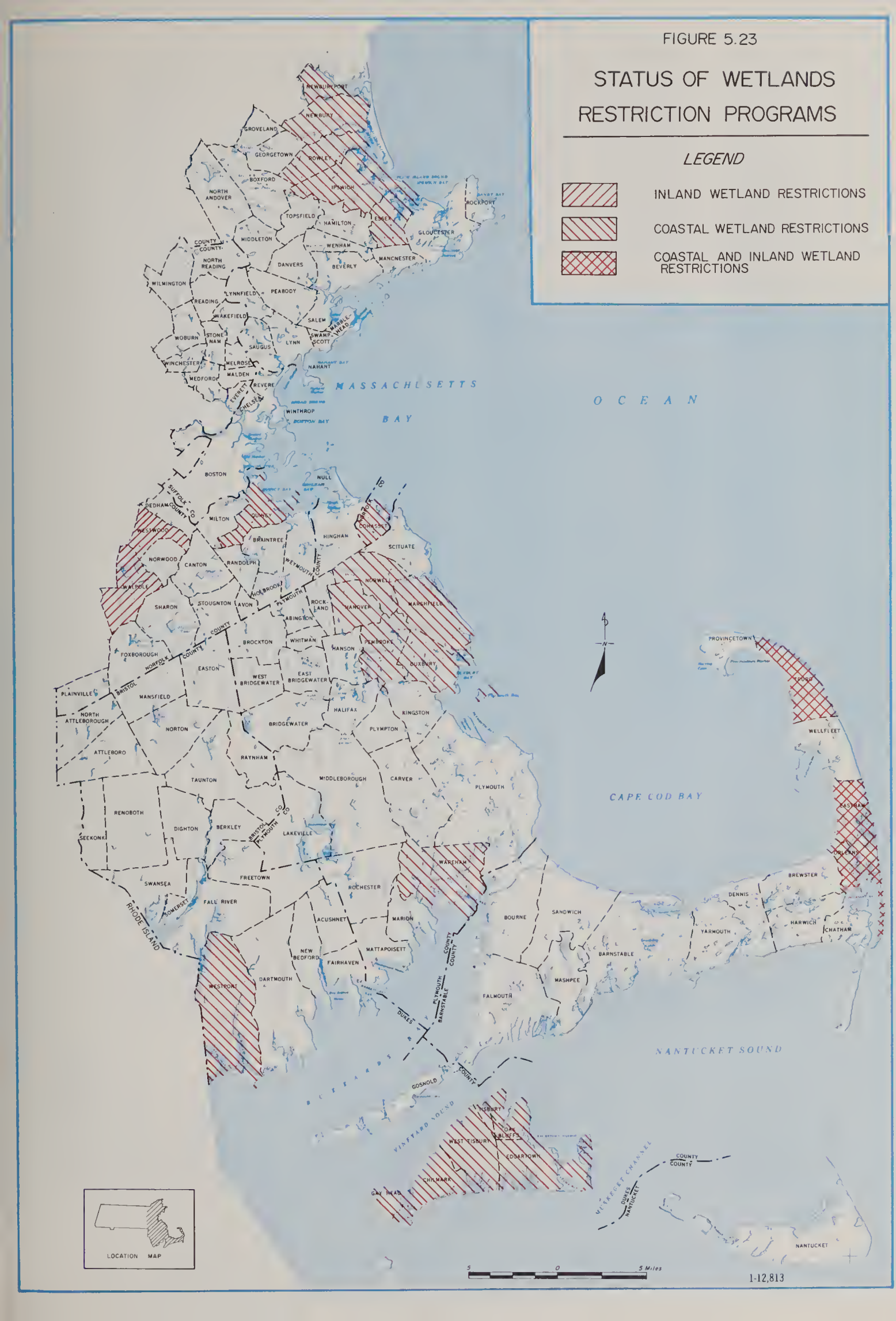
Subject	Agency	Law or Program
Flooding cont.	Farmers Home Administration, PL-566 local sponsors	Watershed Protection and Flood Prevention Loans - These loans provide assistance to local PL-566 sponsors to provide the local cost of improvements for flood prevention, irrigation, drainage, water quality management, sedimentation control, fish and wildlife development, public water-based recreation, and water storage and related costs. Applicants must have authority under state law to obtain, give security for and raise revenue to repay the loan and operate and maintain the facilities to be financed. The total amount of loans outstanding in any one watershed is limited to $5,000,000.
Erosion and Sediment	U.S. Soil Conservation Service, Conservation Districts, landowners	Conservation Operations Program - Landowners and communities are assisted in their efforts to control erosion and sediment and in other conservation efforts by the Conservation Districts. The districts coordinate assistance from the Soil Conservation Service, the Extension Service, the Massachusetts Division of Forests and Parks in cooperation with the U.S. Forest Service for forest lands, and from other state and federal agencies.
Wetlands	Mass. Department of Environmental Management, Department of Environmental Quality Engineering	Massachusetts General Laws, Chapter 131, Section 40 - The "Hatch Act" passed by the Massachusetts General Court in 1965, attempted to control the alteration of the wetlands. This act has been modified several times by the General Court. The comparable legislation in force today is Chapter 131, Section 40 of the General Laws as amended by Chapter 818 of the Acts of 1974 and Chapter 363 and 334 of the Acts of 1975. This act controls, but does not ban development on wetlands. The law requires that any person or governmental agency intending to remove, fill, dredge, or alter a wetland must insure, by following various procedural and technical steps, that the activity will have no adverse effect on water supplies, flood prevention, pollution prevention, or fisheries protection. In effect the act requires an owner desiring to develop his wetlands do so in accord with public interest and safety. Chapter 131, Section 40, now called the Wetlands Protection Act is administered by town or city conservation commissions or the city mayor or town selectmen in communities without conservation commissions. Appeals from local decisions go first to the Massachusetts Department of Environmental Quality Engineering and, if unresolved at that level the courts become the final arbitrators.
	Mass. Department of Environmental Management, municipalities	Massachusetts General Laws, Chapter 131, Section 40A - The Inland Wetlands Restriction Act allows the Massachusetts Department of Environmental Management to place restrictions on the use of inland wetlands. The Act allows the Commissioner of the Department of Environmental Management to regulate, restrict, or prohibit dredging, filling, removing, or otherwise altering or polluting inland wetlands. Restrictions under this Act have been imposed in several communities in the Coastal Region. To reach this final stage, inland wetlands have to be mapped, and all assessed owners of land within these designated wetlands, must be notified. A public hearing is then held in the community or watershed area. After the public hearing, the town selectmen or city council have to approve the restriction orders in their community. If the community officials fail to approve, the commissioner may override their decision after a six-month waiting period. Redress for unsatisfied landowners is through the courts. Massachusetts General Laws, Chapter 130, Section 105 - A similar program to the Inland Wetlands Restriction Act is available to protect saltwater wetlands. Progress in implementing the saltwater wetlands restriction program has been more dramatic than the inland restriction program. Nearly 18,500 acres of saltwater wetlands have deed restrictions filed. Status of the inland and saltwater restriction program is indicated in Figure 5.23.

FIGURE 5.23

STATUS OF WETLANDS RESTRICTION PROGRAMS

LEGEND

- INLAND WETLAND RESTRICTIONS
- COASTAL WETLAND RESTRICTIONS
- COASTAL AND INLAND WETLAND RESTRICTIONS



1-12,813

Subject	Agency	Law or Program
Wetlands cont.	Mass. Division of Fisheries and Wildlife, Mass. Division of Forests and Parks	Massachusetts state agencies, in particular, the Division of Forests and Parks and the Division of Fisheries and Wildlife have active land acquisition programs. In addition, the Division of Fisheries and Wildlife has given emphasis to wetlands acquisition to permanently protect wetlands having primary significance to fish and wildlife. Major land acquisitions have been made in the Hockamock Swamp in the Bridgewaters and Easton, as well as the Parker River Area on the North Shore.
	Municipalities	Many communities in the region have embarked on conservation area plans which attempt to preserve and enhance the natural resources, and especially the water resources, within the community. Usually this effort is spearheaded by city or town conservation commissions which are authorized to prepare conservation and outdoor recreation plans, acquire open space, land and water areas, prepare and maintain open space areas, and advise local officials on matters relating to conservation subjects.
	Mass. Division of Conservation Services, municipalities, U.S. Bureau of Outdoor Recreation	Federal and state cost sharing funds are available to the cities and towns for use in purchasing conservation open space and recreation areas. The Division of Conservation Services administers the Masshusetts Self-Help Act (General Law, Chapter 40, Section 8C) and administers or coordinates the Land and Water Conservation Program of the Bureau of Outdoor Recreation, the U.S. Department of the Interior, within Massachusetts.
	U.S. Department of HUD, municipalities	In addition to acquisition programs, communities can adopt flood plain zoning ordinances to regulate the use of their wetlands and flood prone area. Restrictions imposed by the National Flood Insurance Program also tend to restrict wetland flood plain development. See the Flooding Section for more details on the National Flood Insurance Program.
	Interested Groups	The Massachusetts Audubon Society, Trustees of Reservations and other similar organizations assist individuals and municipalities in protecting the region's wetlands and other natural resources. These groups engage in various activities including environmental education; acquisition of wetlands, flood plain and other important natural resource areas; wildlife sanctuary and reservation management; and assistance to the region's cities and towns in their respective wetland and other resource programs.
Water Quality	Environmental Protection Agency, Mass. Division of Pollution Control, Mass. Division of Environmental Health, municipalities, industries	Restoration and maintenance of water quality has been the result of a combined effort by the federal, state, and local governments; and private industry. The primary federal agency concerned with water quality is the Environmental Protection Agency. The Massachusetts Department of Environmental Quality Engineering is the lead state agency. Important divisions include the Division of Water Pollution Control and the Division of Environmental Health.

Subject	Agency	Law or Program
Water Supply	U.S. Dept. of Commerce municipalities	Grants and Loans for Public Works and Development Facilities - This program provides grants of up to 50 percent of the development cost for such public facilities as water and sewer systems, and flood control projects. Jurisdictions designated as redevelopment areas may qualify for grants and loans. These areas may be counties, labor areas, or larger cities characterized by high unemployment or low family income. Severely depressed areas that cannot match federal funds may receive supplementary grants to bring the federal contribution up to 80 percent of the project cost. Loans are also available for public works and development facility projects. These loans may pay the full cost of a project and may run for as long as 40 years, the interest being determined by government borrowing costs. A community that is unable to raise its share of the eligible project cost may receive a grant for 50 percent or more of the project and a federal loan for the remainder of the cost.
	Mass. Water Resources Commission, municipalities, other units of government	Water Favorability Studies - Under General Laws Chapter 21, Section 9, this program provides for studies of water favorability in areas of the Commonwealth where there may be a need for such a determination. Upon application of a county, conservation district or upon joint application by two or more municipalities, fire districts or water districts or regional district planning commissions, the Water Resources Commission may contract with any agency of the United States or with private firms to conduct water favorability studies within the jurisdictions indicated in the application. The applicants must provide one-half of the nonfederal cost, and special funding must be provided by legislation for the remainder.
	Mass. Division of Conservation Services, municipalities	Massachusetts Conservation "Self-Help" Act (G.L. Chapter 132A, Section 11 as amended) - The Massachusetts "Self-Help" Program makes funds available to communities for acquiring conservation-recreation lands. Improvements on land acquired with the help of the Self-Help Program, may include such things as informal playfields, trails, access roads comfort stations, water impoundments, or wells and campsites. Reimbursements are available only to those municipalities which have established conservation commissions by accepting the provisions of Chapter 40, Section 8C of the General Laws. In addition, a Natural Resource Open Space-Recreation Plan must be filed with the Division of Conservation Services. The land must be controlled by the Conservation Commission after purchase by the community and accessible to any resident of the Commonwealth. An approved project may receive up to 50 percent of the cost of acquisition. If the community is also receiving federal funding assistance under a federal program, the addition of Self-Help funds may involve reimbursement of up to 75 percent of the total cost of the project.
	Environmental Protection Agency, municipalities	Drinking Water Supply-Technical Assistance - Under provisions of the Public Health Service Act (PL 93-523, as amended) the Environmental Protection Agency assists state and local water supply regulatory agencies and public water supply regulatory agencies and public water supply operators and officials to assure that water supply systems serving the public meet minimum National standards for the protection of public health.

EXISTING PROGRAMS

Subject	Agency	Law or Program
Water Supply	Farmers Home Administration, municipalities	Water and Waste Disposal Systems for Rural Communities - These loans and grants may be used for the installation, repair, improvement, or expansion of a rural water system including distribution lines, wells and pumping facilities. Installation, repair or improvement of a rural waste disposal system are also included. Loans may not exceed $20,000,000. Grants are limited to $1,000,000.
Recreation	Farmers Home Administration, landowners	Recreation Facility Loans - These loans are intended to assist farm owners to convert all or portions of their farms to income-producing outdoor recreational enterprises to supplement farm income. Funds may be used to: (1) develop land and water resources, (2) repair and construct buildings, (3) purchase land, equipment, livestock, and related recreation items. Recreation enterprises that may be financed include: campgrounds, horseback riding stables, swimming facilities, shooting preserves, nature trails, and lakes and ponds for boating and fishing. Loans cannot exceed $100,000.
	Landowners	Massachusetts General Laws, Chapter 27, Section 17C - The act limits the liability of landowners who allow recreational use of their property by the public. The obvious purpose of the act is to eliminate the liability that serves as a deterrent to providing recreational opportunities and which encourages the posting of land against trespass.
	U.S. Forest Service, Mass. Division of Forest and Parks, landowners	Recreation Systems of the Forest Service Renewable Resources Program assists landowners to provide forest land recreation opportunities. See the Land Use - Forest Land Section for more details on the Renewable Resources Program.
	Mass. Department of Environmental Management	An Act to Protect Scenic and Recreational Rivers and Streams - This act authorizes the Commissioner of Environmental Management to adopt, amend, or repeal orders regulating or prohibiting dredging, filling or altering scenic and recreational rivers and streams. A Pilot Program under this act is being developed for the North River.
	Mass. Division of Conservation Services, municipalities, U.S. Bureau of Outdoor Recreation	Self-Help Funds, and Federal Land and Water Conservation Program - Chapter 132A, Section 11 of the General Laws assists conservation commissions in acquiring land for conservation and developing outdoor facilities. The Land and Water Conservation Fund also provides cost sharing assistance to finance recreation and open space programs.

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10/ Kingsley, Neal P., "The Forest Landowners of Southern New England" in U.S. Department of Agriculture Resource Bulletin NE-41, 1976.

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13/ MacConnell, W. P. et al., Remote Sensing 20 Years of Change in Suffolk and Norfolk Counties, 1951-1971, University of Massachusetts, Amherst, Massachusetts, 1975.

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18/ Ibid

19/ Ibid

20/ Statewide Small Game Harvest, Massachusetts Division of Fisheries and Game, Westboro, Massachusetts, 1971.

21/ An Office of Biological Services Project, U.S. Department of the Interior Contract 14-16-0008-1186.

22/ Massachusetts Department of Environmental Management, Massachusetts Outdoors Statewide Comprehensive Outdoor Recreation Plan, Massachusetts Department of Environmental Management, 1976.

6 FUTURE-WITHOUT-PLAN CONDITIONS

6.1 DEFINITION AND USE

The Principles and Standards for Planning include a major step to "evaluate resource capabilities and expected conditions without any plan." This involves an appraisal of future economic and environmental conditions expected without a plan, so that these conditions may be compared with those desired by people for the planning area.

Thus, for a selected future date, projections will be made which reflect the inventory and capabilities of the natural resources, the trends which are likely to continue into the future, and the effects of any authorized projects which may alter conditions in the region. The "without-plan" portion of the title implies that the future conditions are to be projected without consideration of any projects which may be in planning stages. This restraint makes it possible to project future conditions which could be expected in the absence of any new programs or projects. Obviously, it makes little sense to embark on an elaborate planning process followed by detailed implementation schemes, if existing authorized projects combined with expected changes will meet the projected demands in a resource area.

The Massachusetts Water Resources Study is concerned with projecting future conditions to the year 1990.

6.2 IMPLICATIONS OF ECONOMIC AND SOCIAL PROJECTIONS TO ENVIRONMENTAL CONSIDERATIONS

As Chapter 4 pointed out, 1990 population projections show an increase of 14 percent (with seasonal population included, 27 percent). Economic activity is also projected to increase, especially service-related enterprises. The potential impact on the environmental quality in the region need not be adverse. Since service-related activities are expected to grow the most (especially relative to manufacturing), environmental impacts are expected to be less adverse. As mentioned previously, the SENE report concluded that projected increases in population and economic activity would not be limited by the region's water and related land resource base, if proper land use guidance were implemented. Given the present array of restrictive land use legislation, plus legislation providing state funding for purchase of development rights, it would appear that adverse environmental impacts will be minimal. Of course, this presupposes that present federal and state environmental laws will not be changed significantly.

6.3 DESCRIPTION OF FUTURE-WITHOUT-PLAN CONDITION

A. Agricultural Land

As noted in Chapter 5, existing land use laws and regulations have been incorporated in the projections (Chapter 4). The statutes that appear to be the most effective are those that have preservation as their primary objective. Agriculturally related land use laws seem to have little effect on the losses of such land; thus, the historical trend was adjusted only to weigh the recent trends more heavily than the earlier trends. It should be noted that, if current trends continue, the region will continue to lose agricultural land.

With respect to stated public policies and goals, especially regarding agricultural preservation and proper siting of future developments, the future is cloudy, at best. Subdivision control statutes are limited, since approval is not required if such developments occur along existing public roads. Unless additional controls are incorporated, land use guidance will not be forthcoming and, thus, there is some possiblity that the resource base and the environment may be adversely effected. Without such guidance, review, or approval procedures, impacts of development will remain somewhat indeterminate.

In December of 1977, the General Court of Massachusetts enacted legislation which would provide $5,000,000 to support a pilot development rights program wherein rights are purchased from private land owners. The impact upon agricultural land preservation could be significant. For example, ownership costs (taxes) would be lower because assessments would be based upon agricultural production value rather than market value for developable land. Since development would not be permitted, farmland would, therefore, be less costly to purchase, which may result in lessening the barriers to entry.

B. Forestland

To determine the future-without-plan condition, it was assumed that forestland will continue to decrease at the rate of approximately 2,700 acres per year, and that forest management efforts will continue at approximately 1976 levels. Presently, an estimated 181,000 acres are assumed to be under some type of forest management.

Wood Products--Future urban development will have two effects on wood product production. It will decrease the area available for wood production, and it will decrease the average productivity of the region. Sites that are the best for growing trees are among the best for development. These sites will be among the first to be lost to urban expansion, and the future productivity of the region will decrease. Only 19 percent of the trees removed in land clearing operations are utilized for forest products and fuelwood. So, land clearing does not contribute significantly to wood product production in the region.

Given the present support level of programs to provide incentives and to educate landowners on forest management, many will continue to let their trees grow unmanaged. Landowner attitudes will discourage new wood-using industries from coming into the region, and there will continue to be a lack of a market for low quality products.

Fuel wood harvesting will increase because of the energy crisis, but this increase could be offset by the decrease in forestland area.

Future wood product production should remain constant or decrease slightly, given the above assumptions. The harvest will remain at about 2 million cubic feet per year, which will result in the disturbance of 7,600 acres of forestland annually.

Water--As long as land in forest cover receives proper management, it will continue to produce sediment-free water. Forestland will remain the dominant land use in the region; therefore, the forest resource will continue to supply a good quantity of high quality water.

Forage--Grazing of livestock on forestland is not a major use now, nor will it become a major use in the future.

Wildlife--The amount and kind of wildlife available in an area depends on the habitat in the area. The majority of the land area is forested, and there are many wetlands to provide diversity needed for good habitat. This is expected to continue into the future.

With the small amount of harvesting taking place, the forests will mature and this will change the kind of wildlife found in the area. As one stage of forest succession goes to another, the animal community associated with the first also gives way to a new community. Even though wildlife will remain in the region, access to the wildlife for both consumptive and nonconsumptive uses will continue to be a problem. As the area becomes more urban and ownerships become smaller, there will be more posting of land.

Recreation--Future recreation needs will not be fully met through the year 1990. The forestland has the physical capacity to support the development of almost any required number of campsites, picnic areas, and trails. The problem will continue to be one of public access and an insufficient number of developed facilities. (See Table 7.4)

C. Inland Flooding

As a result of the National Flood Insurance Program, many communities in the region are adopting land use regulations which will severely restrict the development of flood prone areas. Flood plain development in towns which are not enrolled in the Flood Insurance Program will be limited by the unavailability of federally supervised mortgage money in flood prone areas. In addition, communities are becoming more cognizant of the importance of flood plain management to discourage improper land use.

As a consequence of the situation stated above, inland flood damage potential in most of the Coastal Region is not expected to significantly increase by 1990. Changes could occur in individual subwatersheds, if unexpected industrial or commercial development were to occur in the old mill buildings which are located along the region's rivers. Inflation will, of course, increase the total dollar damage potential, but the physical damage is expected to remain essentially unchanged.

There are two exceptions to this "future-without" plan condition. The first is the Diamond Brook Watershed located in Walpole, Massachusetts (subwatershed NE-18). As indicated in Chapter 5, Diamond Brook Watershed has been approved for construction of a multiple-purpose floodwater retarding and fish and wildlife structure, channel enlargement, and an enlarged floodwater conduit under the center of Walpole. Construction of this project under PL-566 will significantly reduce flood damage potential in the Diamond Brook Watershed.

The Corps of Engineers has an authorized project which will significantly reduce flood damage on Furnace Brook (NE-22) in Quincy by the installation of a system of new and enlarged floodwater conduits to convey flood flows. Channel modifications and installation of greatly enlarged conduits are planned.

Flood damages anticipated in 1990 are indicated in Table 6.1.

D. Wetlands

The future status of wetlands loss in the region will in large measure be determined by the effectiveness of the Wetlands Protection Act and the Inland and Coastal Wetlands Restriction Acts. The ownership and zoning of the wetlands will also be a factor in determining the potential for loss of wetlands.

Wetlands Protection Act applications have been reviewed for a sample of 85 communities in the state. The sample indicates that in 1976, nearly 290 acres of the 80,800-acres of inland wetlands in the sampled communities had received alteration permits. An analysis of building permit data for the last ten years showed that construction expenditures for 1976 were being made at a rate nearly 15 percent above the 10-year average. In view of this, the 1976 loss of inland wetlands figure, approximately 0.4 percent per year, is considered appropriate for use here.

Publicly owned wetlands are in less danger of being lost to development than privately owned areas. Surveys of the inland wetland areas indicated over 14 percent were owned by government or some quasi-public body, such as the Massachusetts Audubon Society or Trustees of Reservations. Zoning can also affect the rate of wetland loss. Conservation and flood plain zoning of wetlands will tend to preserve wetland areas, while industrial or commercial zoning indicates a potential danger to the wetlands. Nearly 46,000 acres or 29 percent of the inland wetlands were placed under special regulations such as flood plain, wetland, and conservation zoning.

TABLE 6.1 - PROJECTED 1990 FLOOD DAMAGES[1/]

Subwatershed		100-Year Flood Damage	Average Annual Damage
		-Parker River Watershed-	
PA-2	(Little River)		2/
PA-3	(Parker River)		2/
		-Ipswich River Watershed-	
IP-4	(Ipswich River)	2,020,000	121,200
		-North Shore Watersheds-	
NS-5	(Annisquam River)	115,800	20,900
NS-6	(Danvers River)	517,800	93,100
NS-7	(Saugus River)	1,635,000	179,800
NS-8	(Mystic River)	108,000	19,400
		-Neponset River Watershed-	
NE-17	(Neponset River)		2/
NE-18	(Diamond-Traphole Brooks)	647,000	79,300
NE-19	(Neponset River)	73,000	8,100
NE-20	(Neponset River)	600,000	36,000
NE-21	(Pine Tree Brook)		2/
NE-22	(Neponset River)	600,000	66,000
		-South Shore Watersheds-	
SS-23	(Town River)	4,385,000	482,500
SS-24	(Monatiquot River)	355,200	21,400
SS-25	(Smelt Brook)		2/
SS-26	(Weir River)		2/
SS-27	(North River)		2/
SS-28	(South River)		2/
SS-29	(Jones River)		2/
SS-30	(Eel River)		2/
SS-31	(Cape Cod Canal)		2/
		-Taunton River Watershed-	
TA-47	(Town River)		2/
TA-48	(Matfield River)	437,400	26,300
TA-49	(Shumatuscacant River)		2/
TA-50	(Winnetuxet River)		2/
TA-51	(Taunton River)		2/
TA-52	(Taunton River	182,400	10,900
TA-53	(Nemasket River)		2/
TA-54	(Mill River)	122,600	7,300
TA-55	(Rumford River)		2/
TA-56	(Threemile River)	835,800	50,200
TA-57	(Taunton River)		2/
TA-58	(Assonet River)		2/
		-Narragansett Bay Watersheds-	
NB-59	(Palmer River)		2/
NB-60	(Ten Mile River)	2,049,600	367,900
NB-71	(Quequechan River)		2/
NB-72	(Cole River)		2/
		-Buzzards Bay Watersheds-	
BB-41	(Agawam River)		2/
BB-42	(Weweantic River)	488,000	88,000
BB-43	(Crane Brook)		3/
BB-44	(Mattapoisett River)		2/
BB-45	(Acushnet River)	211,800	38,200
BB-46	(Westport River)		2/
		-Cape Cod and Islands-	
	All Cape Cod and Islands subwatersheds have less than $5,000 in average annual damage.		

1/ Price Base 1976.
2/ Average Annual Damage less than $5,000.
3/ Crane Brook damage figures have been included with those for the Weweantic River.

Considering historical wetland losses, adjusted for variations in construction activity and factoring in the effects of public ownership and protective zoning, indicates a projected loss for inland wetlands of about 8,900 acres between 1977 and 1990.

Loss rates for saltwater wetlands were not projected, but they are assumed to be very low. Saltwater wetlands are also within the 100-year tidal flood plain affording protection through the Federal Flood Insurance Program which restricts building in 100-year flood zones. Since nearly 45 percent of the saltwater wetlands are already protected by the Coastal Wetlands Restriction Program, future losses are expected to be minimal.

Discussions with personnel involved with the inland and saltwater wetland restriction programs indicated that, if the programs continue at their present rate, restrictions will be imposed by 1990 on over 26,000 acres of inland wetlands, and 41,000 acres of saltwater wetlands in the region.

TABLE 6.2 - WETLAND STATUS AND PROJECTIONS

Present Status		
Total Inland Wetlands (1977)		159,510 acres
1. Wetlands in public or quasi-public ownership	(22,740 acres)	
2. Wetlands in areas under special regulations[1/] (Conservation Zoning)	(45,980 acres)	
3. Privately owned wetlands restricted under General Laws, Chapter 131, Section 40A	(2,350 acres)	
"Protected" wetlands (1, 2, and 3)		71,070 acres
Wetlands protected only by General Laws, Chapter 131, Section 40, in 1977		88,440 acres
Projections (1977 to 1990)		
4. Additional public acquisition	(20,800 acres)	
5. Additional Chapter 131, Section 40A restrictions[2/]	(23,760 acres)	
6. Projected development loss	(8,930 acres)	
Additional protected or lost wetlands (4, 5, and 6)		53,490 acres
Wetlands protected only by General Laws, Chapter 131, Section 40, in 1990		34,950 acres

1/ Excludes wetlands in public ownership or restricted under Massachusetts General Laws, Chapter 131, Section 40A.
2/ Excludes wetlands in public ownership.

Twenty-four cities and towns have had their coastal wetlands and tidal flats restricted under Massachusetts General Laws, Chapter 130, Section 105, the Coastal Wetlands Restriction Act. It is expected that the program will be implemented as vigorously as it has been in the past, and that the remaining 44 towns with coastal wetlands will be in the restriction program by 1990.

E. Erosion and Sediment

Erosion problems resulting on forestland being harvested, roadbanks, unpaved roads, gravel pits, and streambanks are expected to be managed and controlled by existing programs and services. Existing programs, as presently administered, will not be able to bring erosion losses to an acceptable level on cultivated farmland, construction areas, or related critical erosion areas, such as road cuts with unstable slopes, sand dunes, and utility rights-of-way.

Without increased funding or emphasis, the Conservation Operations Program of the Soil Conservation Service is expected to be able to meet approximately 35 percent of the existing land treatment needs on cultivated cropland by 1990.

Erosion losses on the 9,500-acres of land being converted to urban uses is expected to be more than 340,000 tons per year without action to regulate and modify developer practices.

There are over 150 identified critical erosion areas in the region which will, in all likelihood, remain problem areas unless some definite program action is undertaken.

F. Water Quality

The Federal Water Pollution Control Act Amendments of 1972 have as an objective the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters. To achieve this objective, two major goals were established: 1. To attain swimmable-fishable waters by 1983, and 2. to achieve zero discharge of pollutants by 1985.

Point sources of pollution have been the major emphasis of the clean-up efforts to date. Hundreds of millions of dollars have been, and will continue to be, spent to meet the enormous costs involved in constructing and operating wastewater treatment plants.

Although the objective of the 1972 Amendments to the Water Pollution Control Act will be expensive and difficult to achieve, public sentiment for clean water is overwhelming. Major pollution problems still exist in the Charles River, Taunton River, and New Bedford Harbor. These are areas close to heavy concentrations of population and, thus, in areas where the demand for clean water for other uses is also great.

The SENE study found, and we agree, that the "existing programs, authorities, and institutions are good enough" to meet the water quality goals. "The basic need is for better use of these (existing) tools, not more tools."

Alternatives for meeting the remaining water quality problems are presented in detail in the SENE study and in the Water Quality Management plans published by the Massachusetts Division of Water Pollution Control, and we see no purpose in repeating the information. The subject of water quality will not be carried further in this report as an individual study concern, but will only be addressed when it overlaps another concern, such as land use, or erosion and sediment. These areas of overlap will be restricted to the water quality effects of nonpoint pollution sources and alternatives for minimizing the problem.

The Water Quality Management Plans being prepared under Section "208" of the Federal Water Pollution Control Act should indicate what is needed to meet water quality goals in the region. The magnitude and seriousness of nonpoint pollution sources should be more clearly understood after completion of the plans. Measures to alleviate nonpoint problems will follow the evaluation of problem extent.

G. Water Supply

The Southeastern New England (SENE) Study and the Northeastern United States Water Supply (NEWS) Study both concluded that diversion of the Connecticut River water would be needed to meet the 1990 needs of the Metropolitan District Commission communities. Proposals have also been presented to alleviate some of the need for diversion by reducing excessive leakage in distribution systems, other conservation measures, exploring for groundwater resources in the member communities, and by possible additional utilization of the Sudbury River as a water source. The SENE Study concluded that "while several water supply alternatives may be potentially important to the MDC's future supplies, and while water conservation measures can result in significant savings, neither the individual alternatives nor combination of them has the potential to fully meet the MDC's projected short-range water supply needs of 77 million gallons per day." In contrast, the Connecticut River Diversion would supply the MDC's needs through the late 1980s.

The Massachusetts Water Resources Study agrees with the findings of the SENE Study in regard to water supply for the MDC communities. As a result, this study assumed that all of the communities currently being supplied or expected to be supplied by the MDC would be able to meet 1990 demands, by development of the Connecticut River Diversion or by some other supply development or a combination of water conservation and additional supply.

Communities in the category include:

Northeast		Southeast
Boston	Peabody	Quincy
Canton	Revere	Stoughton
Chelsea	Saugus	
Everett	Stoneham	
Malden	Swampscott	
Marblehead	Wakefield	
Medford	Winchester	
Melrose	Winthrop	
Milton	Woburn	
Nahant		

Some of the communities in the region presently have sufficient developed municipal water supplies to enable them to meet 1990 demands. These fortunate communities include:

Northeast	Southeast	Cape Cod & Islands
Danvers/Middleton	Fairhaven	Bourne
Essex	Fall River	Falmouth
Lynn*	Hanover	Harwich
Lynnfield	Marion	Edgartown
Manchester	Mattapoisett	Gosnold
Newburyport*	Seekonk	Nantucket
Rowley	Somerset	Tisbury
Wenham	Swansea	
	Taunton	
	Wareham	
	West Bridgewater	
	Weymouth	

* Increased storage capacity required.

In addition, the towns of Berkley, Carver, Plympton, Rochester, and Gay Head are expected to be able to meet projected 1990 demands with private water supplies.

The Massachusetts Executive Office of Environmental Affairs has recently developed a "Water Supply Policy Study" for the state. The study utilized available data whenever possible. Data from the recently completed Southeastern New England (SENE) Water and Related Land Resources Study, prepared under the direction of the New England River Basins Commission, has been included to the fullest extent.

The Massachusetts Water Supply Policy Study recommended the following:

"Supply Management Policies

1. Require that water utility systems and those concerned with private supplies of water continue to give paramount consideration to health and safety needs. High priority should be given to insuring that water supplies are developed to meet such needs, particularly where imbalances exist and where a complementary demand management policy is in effect.

2. Guide and control supply planning by water utilities through conditional grants, financial incentives, and state review and approval procedures.

3. Encourage and assist water utilities to draw upon water sources within their own watersheds. Before allocation of the water resources of any of the Commonwealth's 12 major watersheds for interbasin transfer, the receiver shall demonstrate, pursuant to the Massachusetts Environmental Policy Act, that environmental effects are within acceptable limits; that local options have been exhausted, including efforts to preserve and restore potential ground and surface water supplies within the acquiring basin, and to maintain and restore the function of watershed areas; and that effective water conservation measures have been established.

4. Encourage the planning of local water supplies and watersheds to include, when consistent with Policy 4.C.1.1., multiple uses such as recreation, fish and wildlife habitat maintenance, protection of natural systems, and enhancement of aesthetic values.

5. Establish standards for and monitor minimum stream flows and pond or lake levels, and regulate withdrawals of ground and surface water to assure preservation of water-dependent natural areas, coordinating the monitoring of interstate streams with other states.

6. Encourage and assist water supply utilities to: develop or expand existing and new groundwater resources prior to seeking additional surface supplies; develop the multiple use potential of new and existing surface supplies in a manner consistent with Policy 4.C.1.1., such as establishing adequate facilities for treatment of the water; acquire, protect for quality, and manage the recharge of groundwater areas and watersheds to the extent necessary to postpone treatment as far as possible; and enhance potability and avoid contamination through the rehabilitation and improvement of supply facilities.

7. Include desalination as an integral part of long-range supply planning.

"Demand Management Policies

1. Require statewide water conservation efforts, including the use of water saving appliances in all new construction, maximization of industrial and commercial multiple usage of water, and reduction of evaporative uses where feasible. Require the MDC, and all regional and local water suppliers to institute mandatory conservation measures consistent with the statewide water conservation program, applying to those efforts the criteria of achievement of such estimates of minimum water needs as the state, through the Water Resources Commission, may establish.

2. Require metering of all water utility deliveries and accelerate programs to install, maintain and replace meters in all local systems, giving priority to systems having the greatest amount of unaccounted-for water.

3. Require the rehabilitation of supply and distribution facilities which show large quantities of unaccounted-for water.

4. Encourage and assist water utilities to promote recycling of industrial process water and renovated municipal wastewater.

5. Require the Water Resources Commission to study water rates set by all publicly and privately owned utilities and recommend legislation on pricing, consistent with state water policy.

"Administrative Management Policies

1. Encourage new programs and new financial commitments by the federal government in support of state and local comprehensive water resource planning, protection, and management activities. Such federal programs for water resources should be of the "block-grant" type permitting maximum flexibility to state governments in their formulation and administration.

2. Centralize department-level water resources planning, policy making and implementing in a single agency charged with the following responsibilities:

   - to prepare and maintain an assessment of water resources by watershed areas;

   - to coordinate and guide watershed planning;

- to administer technical assistance and grant programs;
- to prepare "water budgets" and plans for all water uses, including recreational waters;
- to advise the Secretary of Environmental Affairs on water rights and water allocation questions;
- to develop a formal process to deal with interbasin transfers and recommend agreements acceptable to all parties in specific interbasin transfer cases;
- to monitor stream, pond, lake and aquifer withdrawals and the treatment thereof;
- to review local water rates;
- to develop and maintain an on-going community liaison program; and
- to regulate and administer such other matters as may affect the public health, safety, and welfare.

3. Until the establishment of a centralized water resources agency, authorize and direct the Water Resources Commission to take the following high priority actions to:

   a. Initiate a statewide water conservation program.

   b. Provide technical assistance to local communities, particularly for monitoring the quality of all water supplies, for advising on local supply options, for securing federal and other grant programs, and for conducting conservation programs.

   c. Initiate state level responsibilities for broad, long-range water supply planning, coordinating with regional planning agencies, and using defined watershed areas for basic analysis.

   d. Institute a process which effectively provides for public input in the review and arbitration of water rights questions among competing uses and users; in advising the legislature on questions of water allocation among communities; and in studying and recommending changes needed to administer state policy.

   e. Establish a process for planning and development of water resources and related activities at the local, regional, and state levels which involves citizens and which assures full review and consideration of environmental factors and values, land use controls, and

techniques and institutional procedures (such as advance land acquisition) to minimize future costs and disruptions associated with development. Assure that the Secretary of Environmental Affairs, in designated areas of critical environmental concern, considers water resources and water supply values.

f. Encourage regionalization of water supply systems where necessary, following standards of economic and technical feasibility, and in accordance with state growth, environmental protection, and water policy."

SOURCE: Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Massachusetts Water Supply Policy Study, Boston, Massachusetts, April 1978, pp. 115-119.

There is no need to repeat the work of either the SENE, NEWS, or State Water Supply Policy Study in the area of water supply. Therefore, the water supply analysis will not be carried beyond this chapter. Those desiring detailed water supply data are referred to the previously completed studies.

Information concerning potential surface water reservoir sites which appear to be suitable for development as municipal water supply reservoirs is found in Appendix A of this report.

H. Recreation

Recreational planning in Massachusetts is guided by the Statewide Comprehensive Outdoor Recreation Plan (SCORP) which projects demand for recreation to the year 2000. Supply figures, however, are based upon currently available facilities. Comparison of 1990 demand figures with present supply indicates a huge unmet demand in all of the water-based or water-related activities (swimming, camping, picnicking, canoeing, sailing, and hiking), except swimming. This unmet demand is so large that planned state programs will not satisfy the need. Alternatives will be presented in a later chapter which offer potential to meet some, but nowhere near all, of the potential need.

Of the 318-natural areas identified in the 1974 Massachusetts Landscape and Natural Areas Survey, 172 are now owned by public or private conservation organizations or institutions. By 1990, it is expected that an additional 40 sites will be acquired or protected, making a total of 212 sites in a protected status.

Historical and cultural sites in the region are adequately identified and protected by ongoing efforts of federal, state, and local governments and private individuals and organizations.

Streams in the Coastal Region do not appear to meet the criteria of the Federal National Wild and Scenic River Act of 1968. The SCORP report indicated four rivers with potential for protection under the Massachusetts Scenic and Recreational Rivers Act. Because of uncertainty about implementation of the program, we have assumed that no rivers will be protected under the act for the "future-without project" condition.

Development of public access to ponds and lakes in the region should be increasing in the future, although the magnitude of this increase is difficult to quantify. Conservation commissions are actively seeking to acquire prime areas, many of which are wetlands or include fresh open water. Appendix D indicates the access status of public lakes, ponds, and reservoirs. There have been suggestions made that the Public Access Board should be making a greater effort to acquire formal public access to the Great Ponds of the state. The Wetlands Protection Act, Chapter 131, Section 40, should be effective in preventing loss or harmful alteration of fresh open water areas. The Act is administered by local conservation commissions that are becoming more and more sophisticated and careful in issuing alteration permits.

I. Fish and Wildlife

According to the Division of Fisheries and Wildlife, demand for fish and wildlife recreational opportunities over the next 25 years will increase but to an unknown degree dependent upon various positive and negative factors which are impossible to predict. Participation in hunting and fishing, however, is expected to increase at an average rate of one-half percent per year. Participation in nonconsumptive fish and wildlife recreational activities will likely increase under the stimulus of a state "non-game" program when such is established, and continued publicity involving rare and endangered species.

It is anticipated that the larger game mammals, waterfowl, raptors, upland game, and songbirds will continue to receive major public attention and support. Reptiles, amphibians, rodents, various less visible species, and those animals viewed as pests are expected to attract only minor attention.

7 NEEDS

7.1 INTRODUCTION

Needs may be defined as the unmet demand which will not be satisfied by existing resource management or by implementation of authorized plans or projects. The quantification of needs stems from the evaluation of resource capabilities and expected conditions without a plan. In effect, needs indicate the areas where additional planning, authorization, and implementation is needed to meet the desires of society.

7.2 NEEDS

A. Agricultural Land

Table 7.1 summarizes the needs as determined from the future-without-plan condition relative to the stated problems and objectives. The primary need is to maintain or increase agricultural land. As Table 7.1 shows, there are a number of subneeds that must be met in order for the primary need to be satisfied.

TABLE 7.1 - AGRICULTURAL LAND USE NEEDS

Primary Objectives	Resource Area	Needs
National Economic Development	Agricultural Land	1. Reverse trend of agricultural land loss. 2. Insure proper land use planning to minimize future development on agricultural land.
Environmental Quality	Open land	1. Locate future developments so as to minimize impacts on environmentally sensitive areas. 2. Preserve open land to contribute to an aesthetically pleasing land use mix. 3. Minimize nonpoint pollution agricultural sources.

An interesting aspect within the land resource area is that, by solving the NED problem, much of the identified EQ problem (loss of open land) is also solved. Thus, the needs for the EQ objective in the land resource area are similar to those of the NED objective. There is some dichotomy, however, in that one of the objectives is to increase or, at least, maintain agricultural production. But if this is accomplished, the water resource quality may be adversely effected by continuing or increased levels of nonpoint sources of pollution. Thus, as Table 7.1 summarizes, there is a need for an aesthetically pleasing land use mix, and if such a mix is derived from a continuation of agriculture, then there is another need to minimize nonpoint sources of pollution from agriculture.

One of the most important regional needs is to complete the soil survey. These surveys are extremely useful in providing an inventory of soil types, in providing soil interpretations for guiding certain land uses, and in providing critical area locations.

B. Forestland

By the year 1990, there will be a need for an additional 7.2 million cubic feet of wood products for the region.

The first step in increasing production is to increase the management of public and private forestland for wood products. There will be a need for an increase in forest management for wood products from the present 181,000 acres to 450,000 acres.

Many landowners require incentives to persuade them to manage and not develop their land for other uses. If a landowner is going to manage his land for forest products, he has to see the possibility of selling his products. There is a need to develop diversified markets. To increase management on private forestland, many owners need to be informed on the opportunities and benefits of forest management.

To increase or maintain the environmental quality of the area, there is a need to combine the urban and forest environments in a way that maintains some of the benefits of the forest environment. This can be accomplished by first informing towns about urban forest management, and, secondly, providing technical assistance to towns to manage their urban forestlands.

Additional needs beyond the scope of the material included in this report are areas of study and measures that would complement and strengthen the forest industry sector. At the present time, the secondary wood-using industries reportedly draw nearly all their requirements for wood from areas outside the state. There is a need to study the structure of these industries with a goal of supplying more of their needs from in-state milling plants.

The urban character of the region with attendant development pressures on forestland indicates a need for study of the cost-benefits of land devoted to forestry purposes versus other land purposes. The urban character of the region also indicates a need for study of the economics of tree growing, harvesting, and milling wood within the context of the region's characteristics.

Flooding

One of the objectives of this study of flooding is to develop alternatives to reduce flood damages to an acceptable level. The definition of "acceptable level" is subject to discussion. For purposes of this study, however, total average annual flood damage of less than $5,000 per subwatershed was considered an acceptable level. This is roughly equivalent to a 100-year frequency flood causing $80,000 in damage. Subwatersheds expected to need alternatives to reduce flood damage are indicated in Table 7.2.

TABLE 7.2 - FLOOD DAMAGE REDUCTION NEEDS

Subwatersheds	Description	Average Annual Damage
IP-4	Ipswich River	$121,200
NS-5	Annisquam River	20,900
NS-6	Danvers River	93,100
NS-7	Saugus River	179,800
NS-8	Mystic River	19,400
NE-18	Diamond - Traphole Brooks	79,300
NE-19	Neponset River	8,100
NE-20	Neponset River	36,000
NE-22	Neponset River	66,000
SS-23	Town River	482,500
SS-24	Monatiquot River	21,400
TA-48	Matfield River	26,300
TA-52	Taunton River	10,900
TA-54	Mill River	7,300
TA-56	Threemile River	50,200
NB-60	Ten Mile River	367,900
BB-42	Weweantic River	88,000
BB-45	Acushnet River	38,200

D. Erosion and Sediment

Major erosion and sediment control needs are concentrated in three areas: construction projects, tilled cropland, and other critical erosion areas.

Areas Undergoing Urban Development (construction sites)

From 1952 to 1972, approximately 7,300 acres of nonurban land were converted to urban use per year in the region. During the construction period, soils are usually stripped of vegetative cover and are often left in this exposed condition for extended periods of time. The result can be severe erosion on the site and quantities of sediment released downstream. It is expected that 9,500 acres per year will be converted to urban use by 1990. Gross erosion from these areas is expected to exceed 340,000 tons per year.

Tilled Cropland

Erosion rates on approximately 20 percent of the tilled cropland are excessive. The average annual erosion loss from tilled cropland in the region is 4.3 tons per acre, nearly 40 percent greater than the average tolerable loss of 3 tons per acre for most soils. There are also individual farms within the region which have critical erosion problems on cropland which far exceed the average erosion rate. Cropland treatment needs are summarized in Table 7.3.

TABLE 7.3 - LAND TREATMENT NEEDS (1990)

Measure	Acres Needing Treatment
Residue and cover	800
Sod in rotation	370
Strip Cropping	200
Permanent Cover	1,310
Total Cropland Needing Treatment	2,680

Critical Erosion Areas

In addition to these erosion problem areas, the region has some isolated critical erosion areas which are not being stabilized under ongoing programs. These critical areas include road cuts with unstable slopes, blowing and drifting sand from coastal dunes, and blowing sand from utility rights-of-way which have been scarred by off-road recreational vehicles, and blowing dust from gravel pits. Although these critical areas are not regionally significant in terms of total volume of erosion, the erosion and its effects are locally significant and should be minimized.

Wetlands

According to the wetlands projections in Chapter 6, by the year 1990, over 8,900 acres of inland wetlands will be lost to urban development. An additional 35,000 acres will be protected only by General Laws, Chapter 131, Section 40, the Wetlands Protection Act.

The needs in the area of inland wetlands can be summarized, as follows:

1. Reduce projected wetland loss;
2. provide additional protection to the 80,930-acres of inland wetlands which are not protected by public ownership or the Wetlands Restriction Act;
3. provide additional public access to inland wetlands for passive recreation.

F. Recreation

Recreation needs are indicated in Table 7.4, abstracted from the SCORP report data.

TABLE 7.4 - RECREATION NEEDS

Activity	1975 Supply (1000 Activity Days)	1990 Demand	Needs
Swimming	51,750	45,298	(surplus)
Camping	1,770	3,269	1,499
Picnicking	1,693	15,573	13,880
Canoeing-Sailing	4,428	6,468	2,040
Hiking	1,223	10,793	9,570

The Needs figures require some explanation. Although there is a surplus of swimming facilities available in the region, the distibution of these facilities is not coincident with population. Hence, though there is a surplus of swimming on Cape Cod and the Islands, there is a need for additional beachfront in the northern part of the region.

The large need for picnicking facilities in reality represents a need for picnic tables. In lieu of formal picnic facilities, much of the demand is now, and will continue to be, met by informal picnic sites; i.e., a blanket under a tree.

Likewise, the need for hiking trails may be met with something less than a formally mapped and labelled "trail." Utility rights-of-way, abandoned railroad rights-of-way, rural highways, and even city streets in an historical area, such as the Coastal Region, can serve to provide an enjoyable hiking experience.

Even with these conditional statements concerning needs, there is a large unmet demand, or need, in all five water-related recreation activities. There is also a need to take steps to implement the provisions of the Massachusetts Scenic and Recreational Rivers Act.



Martha's Vineyard, Massachusetts: The fishing boats attest to the island's dual personality as a vacation mecca and year-round home.

8 ALTERNATIVES

8.1 INTRODUCTION

Alternatives designed to meet the needs expressed in Chapter 7 are presented in this chapter for each major study concern. Table 8.4 compares the alternatives with needs and assesses the effectiveness of each alternative. Effects of the alternatives on national economic development, environmental quality, social well-being, and regional development are presented in Table 8.5. Table 8.6 summarizes the potential environmental effects of the alternatives.

8.2 LAND USE ALTERNATIVES

This section addresses the public policy alternatives that are relevant to the problems and needs identified in land use. One alternative is the continuation of present policies. Since such action would not have a positive impact on the problems and needs discussed in this report, the "without plan" alternative is omitted from further discussion.

A. Agricultural Land Use Alternatives

It is apparent, from recent discussions with state officials, that an overriding concern is the preservation or expansion of agricultural land in the hope that production in the agricultural sector may be maintained or increased. Related to this is the desire to maintain a variety of land uses which will continue to provide a good aesthetic and environmental setting, in terms of wildlife habitat and scenic viewing.

Past measures enacted in most states, including Massachusetts, were based upon regulations (i.e., zoning ordinances) and incentives (i.e., agricultural assessments). Given the continuing trend of declining agricultural land, it is apparent that these approaches have not been effective. Regulations have been ineffective for two reasons: 1. Zoning an area agricultural does not necessarily insure that agriculture will be practical. 2. Those owners whose land is zoned low density have a strong economic incentive to press for zoning variances. Historically, applications for zoning variances are often approved.

The incentive or agricultural assessment approach was aimed at decreasing taxes to agricultural enterprises. Although this measure has made staying in agriculture easier, it has not precluded the selling of agricultural land to nonagricultural users, primarily because the tax penalties assessed on such transactions are small in comparison to the amounts received for

those properties. An underlying thought in the preferential assessment approach is that only a little monetary assistance is necessary to keep agricultural firms viable. Little, if any, research has been undertaken to determine exactly how much help is required.

A number of states have recently been considering other means by which agricultural land might be preserved. Vermont and Washington have enacted land sales excise taxes. In Washington, for example, on land sold by an owner of six years or more, no taxes are paid. However, for an owner of less than one year who sells land, the tax amounts to 50 percent of the sales price. Vermont law is similar, though tax percentages may differ somewhat. The main purpose of these laws is to decrease speculative buying of agricultural land with the intent to sell quickly to nonagricultural uses.

A number of states, including Massachusetts, have passed legislation providing for the public purchase of development rights to agricultural land and, thus, precluding other uses. Such a program is a combination of the regulatory and incentive approaches. It is regulatory, in the sense that agricultural areas must be designated for preservation, and it includes incentives, since the income derived from the sale of the development rights can be reinvested in the farm enterprise to increase efficiency and net borrowing power and, thereby, hopefully increasing its competitiveness.

The public investment required in a development rights program is dependent upon the difference in the value of land used for agriculture and the value, if the land were used for development. Thus, in areas that are in close proximity to higher value uses, the public costs per acre in purchasing the development rights would be higher than in areas located further away. After the development rights are purchased, no other uses would be permitted. Such a program has two advantages over those previously mentioned:

1. The sale of development rights will provide compensation to owners of restricted areas.

2. Prospective farmers will require less financial resources to enter farming, since land prices will be based on agricultural earnings, rather than upon potential development values.

Table 8.1 summarizes the component needs of agricultural land and the various alternatives through which such needs may be satisfied.

TABLE 8.1 - SYSTEMS FOR PRESERVING AGRICULTURAL LAND

Component Needs	A Zoning and Preferential Assessment	B Purchase Leaseback	C Development Rights
1. Maintain or increase agricultural protection.	No	Yes	Yes
2. Maintain or increase environmental and aesthetic qualities.	No	Yes	Yes

B. Forestland Use Alternatives

Chapter 7 listed both the NED and EQ needs of the forest resource. Based on these needs, four alternatives are suggested. Three of the alternatives have several subalternatives which, when combined, make up the major alternative. One or all of the subalternatives can be implemented. The four alternatives are:

1. Increase forestland management by increasing the number of personnel working on state and private land providing technical assistance to landowners.

    a. Add four technicians and seventeen woods workers on state forestland;
    b. add a full-time survey crew to locate state forest boundaries;
    c. add six foresters to provide management assistance to private landowners;
    d. add four technicians to assist service foresters;
    e. engage professional forestry consultant firms to accomplish the above, where applicable.

2. Increase incentives to landowners to encourage them to manage their forestland for timber products.

    a. Increase Forest Incentive Program funding by $33,000;
    b. change Chapter 61 of the Massachusetts General Laws (Classification and Taxation of Forestland) by eliminating the ceiling of $400/acre value on forestland;
    c. increase Agricultural Stabilization and Conservation funds in counties where land is valued too high for Forest Incentive Program funds;

d. change liability law to limit landowners' liability for injuries incurred in timber harvesting;
e. revise nursery program to provide free trees to landowners.

3. Establish a program to increase and diversify the markets for forest products, to encourage the utilization of low quality products, and to provide increased marketing assistance to the existing wood-using industry.

   a. Hire two utilization foresters to work in the area at the county level;
   b. encourage the establishment of two plants to utilize low quality products;
   c. develop a fuel wood management program;
   d. provide low interest loans for sawmill modernization.

4. Establish an information and education program to inform private landowners about the benefits of forestland management.

   a. Hire four people to conduct an information and education program throughout the region. This should include metropolitan areas where many nonresident forest landowners live.

The EQ needs can also be met with the above alternatives. The information and education program can inform urban as well as rural landowners. The increases in personnel can provide technical assistance needed in the urban areas.

8.3 FLOODING ALTERNATIVES

Flood damages can be minimized by careful planning and implementation of flood plain management techniques. Flood plain management programs should contain regulatory and corrective measures.

Regulatory measures do not prevent flooding but, instead, reduce the threat of damage or loss of life from floods by discouraging development on flood plains. Regulatory measures include flood plain regulations, development policies, land use restrictions, greenbelts or open space, and flood insurance. Tax adjustments and warning signs are related measures.

Corrective measures, while they do not eliminate flooding, can reduce the extent of flooding and resulting damages. These corrective measures are usually physical measures and can include land treatment, floodwater retarding structures, stream improvements, levees or floodwalls, existing reservoir management programs, floodproofing of structures, relocation of buildings or flood plain reclamation, and flood watch and warning systems.

As noted previously, regulation of development on flood plains is expected to effectively limit increases in flood damages. Corrective measures will also be needed to reduce damage to existing development.

Corrective measures, as described below, are usually physical measures that are designed to reduce or control floods and flood damage.

Land Treatment--Vegetative and mechanical land treatment measures can be installed on the uplands to prevent destruction of land by erosion and reduce the movement of damaging amounts of sediment to the streams and flood plains. Agricultural lands and lands in transition from agriculture to urban uses should be protected or maintained by temporary vegetation, mulch, sediment basins, or other measures to reduce and control erosion. Land treatment measures also slow or reduce runoff and peak flood flows from upland areas.

Floodwater Retarding Structures--These structures are earthfill or concrete impoundments that check the uncontrolled flow of floodwater rushing downstream. The structures are located to protect the largest possible area of land subject to flooding, encroach as little as possible on high value lands, and provide a high level of protection to downstream property.

Stream Modifications--Stream channel changes to increase channel capacity to carry floodwater can be made by straightening, deepening, widening, clearing, or by lining the channel so that flooding will be less frequent and severe.

Dikes and Floodwalls--These are earth embankments or concrete walls built along the bank of a stream to confine flood flows to the channel or floodway. Dikes and floodwalls are normally used to provide protection to high value flood prone areas.

Floodproofing of Buildings--Techniques used to make existing buildings, contents, and grounds located in flood hazard areas less vulnerable to flood damage are:

1. Permanent measures built as an integral part of the structure, such as: raising the elevation of the structure, waterproofing of basement and foundation walls, anchorage and reinforcement of floors and walls, and use of water-resistant materials;

2. contingency measures which require action to be taken to make them effective, such as, manually closed sewer valves and removable bulkheads;

3. emergency measures carried out during floods according to prior emergency plans, such as, sandbagging, pumping, and removal of contents to flood-free areas.

Flood Plain Reclamation--This includes the permanent evacuation of developed areas, subject to inundation and the acquisition of lands by purchase, the removal of structures, and the relocation of the population from such areas. Such lands could then be returned to a natural wildlife habitat or used for agriculture, low intensity recreation, or other purposes which would not interfere with flood flows.

Flood Watch and Warning Systems--The National Weather Service of the National Oceanic and Atmospheric Administration issues warnings of potential flood producing storms. Frequently, the flood warnings are preceded by a "severe weather or flood watch." Local programs can also be implemented to give advance warning to flood prone areas of potential or impending flood danger. On small watersheds with considerable swamp storage, staff gages set at key locations could be monitored by local personnel. Monitoring could be accomplished by the use of float-activated electronic warning signals connected to the police or fire department. All warning systems should be coordinated with local Civil Defense disaster plans.

A. Coastal Region Flooding Alternatives

Three combinations of corrective measures were investigated to illustrate the range of possibilities available to reduce existing flood damage. A summary of the combinations, costs, and remaining damages is presented in Table 8.2.

Land treatment, floodwater retarding structures, stream modifications, and dikes and floodwalls were considered as one combination. These structural measures have been the traditional basis of federally-financed, flood control projects. Reduction in flood damage is achieved by reducing runoff and peak flows or by confining flood flows to established channel or floodways.

Another combination investigated was a floodproofing program to modify existing damageable property. A wide range of techniques was considered to reduce damage at individual locations. Permanent measures, such as the waterproofing of walls, were combined with contingency measures, such as removable flood barriers to safeguard interior areas from floodwaters. Emergency measures to be carried out during floods, such as pumping and removal of damageable material to flood-free areas, were also included in this alternative.

A third plan included the same structural measures, but combined with floodproofing. Land treatment, floodwater retarding structures, and dikes and floodwalls were used to reduce and control flood flows to manageable levels. Floodproofing measures were then utilized to reduce damage remaining from the reduced flows.

A large part of the damageable property in the region is not suited to economical floodproofing. Much of the road and bridge damage can only

TABLE 8.2 - SUMMARY OF ALTERNATIVES TO REDUCE FLOOD DAMAGE

Sub-watershed	1990 Flood Damage		Structural Alternative					Floodproofing Alternative					"Mixed Alternative"				
			Flood Damage with Project		Project Cost[1]		Project Benefits	Flood Damage with Project		Project Cost[1]		Project Benefits	Flood Damage with Project		Project Cost[1]		Project Benefits
	100-Year Flood	Average Annual	100-Year Flood	Average Annual	Total Cost	Average Annual[2]	Average Annual	100-Year Flood	Average Annual	Total Cost	Average Annual[2]	Average Annual	100-Year Flood	Average Annual	Total Cost	Average Annual[2]	Average Annual
IP-4	2,020,000	121,200	725,200	43,600	52,000	3,600	77,600	854,800	51,200	47,000	3,900	70,000	No reasonable mixed alternative.				
NS-5	115,800	20,900	101,400	18,200	23,900	1,600	2,700	76,200	13,700	12,800	1,100	7,200	76,200	13,700	31,200	2,400	7,200
NS-6	517,800	93,100	253,700	45,700	91,500	6,300	47,400	222,400	40,100	123,800	10,400	53,000	229,200	41,300	106,500	7,900	51,800
NS-7	1,635,000	179,800	No reasonably feasible alternative.					No reasonably feasible alternative.					No reasonable mixed alternative.				
NS-8	108,000	19,400	No reasonably feasible alternative.					10,800	1,920	41,600	3,500	17,000	No reasonable mixed alternative.				
NE-18	647,000	79,300	No reasonably feasible alternative.					Detailed nonstructural alternative being developed by Soil Conservation Service under PL-566.									
NE-19	73,000	8,100	No reasonably feasible alternative.					19,000	2,100	2,500	300	6,000	No reasonable mixed alternative.				
NE-20	600,000	36,000	No reasonably feasible alternative.					20,400	1,200	21,900	1,800	34,000	No reasonable mixed alternative.				
NE-22	600,000	66,000	276,000	30,400	200,000	13,800	35,600	336,000	37,000	14,100	1,200	29,000	168,000	18,500	214,000	15,000	47,500
SS-23	4,385,000	482,500	Detailed Planning Investigations now being conducted in this watershed by U.S. Army Corps of Engineers.														
SS-24	355,200	21,400	238,200	14,300	280,000	19,300	7,100	98,200	5,900	47,100	3,900	15,500	27,000	1,700	310,000	22,900	19,700
TA-48	437,400	26,300	377,400	22,700	110,000	7,600	3,600	247,200	14,900	144,900	12,200	11,400	208,800	12,500	247,700	18,300	13,800
TA-52	182,400	10,900	38,400	2,300	180,000	12,400	8,600	96,000	5,800	8,700	800	5,100	No reasonable mixed alternative.				
TA-54	122,600	7,300	104,600	6,200	28,500	1,900	1,100	65,600	4,000	2,500	300	3,300	47,600	2,900	30,200	2,200	4,400
TA-56	835,800	50,200	241,800	14,500	270,800	18,700	35,700	697,800	41,900	13,400	1,200	8,300	103,800	6,200	284,200	21,000	44,000
NB-60	2,049,600	367,900	Detailed Planning Investigations now being conducted in this watershed by Soil Conservation Service under PL-566.														
BB-42	488,000	88,000	--	3/	3,734,000	261,200	88,000	No reasonably feasible non-structural alternative.					No reasonable mixed alternative.				
BB-43	Crane Brook considered an integral part of BB-42 (Weweantic River)																
BB-45	211,800	38,200	--	3/	365,000	25,100	38,200	--	3/	500,000	31,900	38,200	No reasonable mixed alternative.				

1/ Price Base 1976.
2/ Amortized at 6-3/8 percent for 100 years.
3/ Less than $5,000 in average annual damage remaining.

be reduced by reducing floodflows or enlarging the bridge. In other instances, floodproofing can create a potentially dangerous situation by giving residents a false sense of security. Residents may choose to remain in their floodproofed homes, when the more prudent action may be to evacuate to higher ground.

By utilizing floodproofing, in combination with structural measurements, it is often possible to reduce the cost and scope of a structural program while increasing the degree of protection afforded to the area.

Detailed investigations and analyses would be required to establish the most acceptable and effective combination of measures to reduce flood damages in the region. The three combinations considered in this study illustrate a range of possibilities. Final selection of a plan would require significant local inputs, consideration of environmental impacts, and a cooperative effort by local, state, and federal agencies.

In order to limit flood damage to new development and to protect existing property owners from catastrophic loss, all communities in the region should participate in the National Flood Insurance Program. Under the Flood Insurance Program, communities are required to implement regulations and formulate effective flood plain restrictions, such as zoning and subdivision control.

8.4 SEDIMENT AND EROSION ALTERNATIVES

A. Construction Areas

Provisions should be made for the retention of optimum amounts of vegetative cover for watershed protection on all areas undergoing residential, highway, and industrial development and construction. Developers should prepare and follow plans designed to minimize the disruption of the hydrologic balance and the resulting erosion by maintenance of vegetative cover during construction. Contractors should utilize the natural landscape in their planning for environmental purposes. Where needed, developers and contractors should apply erosion control measures, such as temporary debris basins or desilting basins, seeding and mulching of exposed areas, temporary diversions, and forest buffer zones.

Adequate planning prior to construction and close supervision of construction activities are needed to control erosion.

Naturally, developers will be reluctant to utilize erosion control measures, unless they can see some financial, aesthetic, or other tangible benefits. Consequently, sediment and erosion control ordinances and bylaws are needed to ensure compliance with good conservation practices during construction. These ordinances could be additions to present zoning, subdivision regulations, and/or building regulations.

B. Critical Erosion Areas

Isolated critical erosion areas in the region will continue to occur. In order to approach this problem on an orderly basis, we recommend the establishment of a measure in The Pilgrim Resource Conservation and Development Area to inventory and map all critical erosion areas and problem streambanks. This inventory should be updated every 5 years. We also recommend that priorities be established within the RC&D Council to provide technical and financial assistance to stabilize critical areas.

C. Tilled Cropland

The Conservation Operations Program of the Soil Conservation Service can assist landowners in applying conservation measures to prevent erosion on cropland. This technical assistance is coordinated through the conservation district and, in many instances, landowners can obtain cost sharing for installation of practices from the Agricultural Stabilization and Conservation Service.

Fiscal and personnel limitations make it necessary to establish priorities for technical and financial assistance. Priorities for technical assistance are provided by the conservation district board of supervisors in each county. Financial cost sharing program priorities are established by the Agricultural Stabilization and Conservation County Committee.

Since the installation of conservation practices is a purely voluntary effort on the part of landowners, priorities have tended to favor those farm operators who exhibit the most initiative and desire to install practices. The majority of technical assistance work is precipitated by landowner requests. This procedure has resulted in a good deal of assistance being provided to operators who are already highly motivated to install practices and who are aware of the benefits to be obtained from soil conservation efforts.

As a result of priority procedures and limitations on personnel and funding, many of the farms with severe erosion problems have not received much encouragement to install practices to alleviate the situation. However, these are the very operators who require the most encouragement, assistance, and continued follow-up, if they are to reduce erosion losses.

Cost sharing for conservation practices has favored production-oriented measures rather than erosion control practices. Naturally, the practices which are aimed toward increased production and increased farm income are popular with farmer-recipients. Erosion control practices which may result in a decrease in production tend to be less popular, though no less necessary.

If erosion losses on tilled cropland are to be reduced to acceptable levels, more emphasis will need to be placed on locating, contacting, encouraging, and assisting the farmers with the most severe problems.

Since it appears unlikely that significant increases in funding or personnel levels will be forthcoming, other technical assistance and cost sharing measures will need to receive reduced emphasis.

A first step in reducing cropland erosion losses could involve a detailed cropland inventory to assess erosion losses and determine needed treatment for each farm in the conservation district. Priorities for assistance could then be established. SCS technicians should have definite annual goals to contact and assist high priority farm owners. Cost sharing assistance for erosion control practices on priority farms should be allocated the maximum possible funding, even if this acts to the detriment of some of the more popular production-oriented measures. Increased cost sharing for erosion measures with off-site sediment reduction benefits should receive high priority.

It is apparent that increased effort and financial assistance will be required to reduce erosion losses on cropland. The final decision concerning the emphasis to be placed on erosion control in relation to other conservation needs rests ultimately with the conservation districts and the ASCS county committees. A detailed cropland erosion inventory by each district is recommended as a logical starting point to promote discussion of the problems and to establish a coordinated program to meet needs.

8.5 WETLANDS ALTERNATIVES

In order to reduce projected wetland losses and to provide additional protection to inland wetland areas, this study has developed a hierarchy of protective measures to be pursued. The hierarchy is based on the degree of protection provided to the wetlands against unwise development. The basic preference list is, as follows:

1. Public and Quasi-public Ownership.

2. Restrictions under Massachusetts General Laws, Chapter 131, Section 40A, the Inland Wetlands Restriction Act.

3. Areas placed under special zoning regulations.

4. Protection under Massachusetts General Laws, Chapter 131, Section 40, the Inland Wetlands Protection Act.

This list of options was then employed to assist in the development of alternatives for additional wetlands protection.

A. Public Acquisition

Accelerated acquisition of inland wetlands by state, county, city, and town agencies could be implemented to add to the projected acquisition of 20,800 acres. State agency acquisition of wetlands will continue to

utilize existing funds, such as the Inland Fish and Game Fund. In order to accelerate acquisition, particularly by the Wetlands for Wildlife Program of the Massachusetts Division of Fisheries and Wildlife, additional funding from the Massachusetts legislature will be needed.

The Massachusetts Self-Help program should be funded on a regular basis. The U.S. Bureau of Outdoor Recreation's Land and Water Conservation Fund financing has been increased. A portion of the Self-Help funds and some of the Massachusetts share of the Land and Water Acquisition Fund should be earmarked for wetlands acquisition.

Projections indicate that about 20,800 acres of wetlands will be acquired by 1990 through existing programs. A reasonable goal for additional acquisition is 20,000 acres.

Priority for wetlands acquisition should go to the larger wetlands of the region. These larger areas offer more potential for wildlife habitat than a like acreage of smaller units. Management of a large area is also likely to be easier than management of several smaller areas. In addition, the large areas offer the potential for lower per-acre acquisition costs as the interior portions of the areas are likely to be without road access and be less valuable real estate.

The 85-wetlands evaluated by the Soil Conservation Service and further described in Chapter 5 are among the largest wetlands in the region. Of this group, the wetlands with the highest ratings are:

Wetland No.	Name	Size (acre)	Approximate percent Publicly or Quasi-publicly Owned
3	Wenham Swamp	1,970	85
6	Ipswich River	660	5
22	Cedar Swamp	570	5
27	Hockomock Swamp	5,450	60
28	Beech Hill Swamp	580	15
30	Great Cedar Swamp	1,440	5
36	Chartley Brook	600	10
37	Titicut Swamp	430	5
40	Winnetuxet River	710	0
47	New Bedford Reservoir	310	0
48	Rocky Gutter Brook	1,000	85
49	Forbes Swamp	560	0
54	Acushnet Cedar Swamp	1,070	80

The Division of Fisheries and Wildlife is currently acquiring land in Wetland 27, Hockomock Swamp. This acquisition should be continued and early public acquisition should be considered for all of these highest rated wetlands.

B. Inland Wetlands Restriction Act

Progress in implementing the Restrictions Act has been agonizingly slow. Problems have resulted from the low staffing levels and the complexity of the project. Identification and location of wetland areas have been proceeding at an acceptable rate. The time-consuming procedures involve: transfer of wetlands data to assessor's maps, determination of wetland tract ownership, and preparation of legal descriptions of each piece of wetland slated for restriction. A significant increase in staff and funding for the Restriction Program is needed, if more rapid results are to be obtained.

C. Protective Zoning

Conservancy zones can be a useful tool for the protection of wetlands. Flood plain zones, wetland zones, and conservancy zones usually place significant restrictions against development. Nearly 46,000 acres of inland wetlands are now subject to some form of these special regulations. In some instances, only the major wetlands in a town have been included in these specially zoned areas.

Communities are encouraged to establish conservancy zones to protect their inland wetlands from unwise development. Such zoning should be comprehensive and include, as a minimum, all identified wetland areas above 5 acres in size. Communities with partial zoning of wetland areas are encouraged to expand coverage to include all wetland areas of significant size.

8.6 WATER QUALITY ALTERNATIVES

Nonpoint pollution sources need to be evaluated to determine their magnitude and effects on water quality. Results of the Section "208" water quality studies being conducted by regional planning agencies should be an indicator of the extent of nonpoint pollution problems in the region.

Local communities should place more emphasis on soils limitations when planning for growth. Detailed soil surveys made in region towns indicate severe limitations existing for septic tank systems. Communities adopting or updating local zoning ordinances need detailed soils information to intelligently guide growth to suitable areas. In some cases, the use of large residential lot size in certain soils can minimize septic tank-leach field problems, which might develop if smaller lot size and greater density of development were permitted. Conversely, smaller lot sizes may require sewage collection systems because of inadequate soils for onsite disposal.

On the basis of projected population increases and the lack of complete municipal sewerage, the following communities should obtain detailed soil surveys from the SCS to aid in guiding growth:

Chatham	Middleton	Saugus
Eastham	Oak Bluffs	Tisbury
Edgartown	Peabody	Truro
Gay Head	Provincetown	Wellfleet
Lynnfield	Reading	

8.7 WATER SUPPLY ALTERNATIVES

Appendix A of this report identifies 33 locations which have potential as municipal water supply reservoirs. Topography of the potential storage basin, geology of the abutments and foundation, and land rights costs appear to be favorable.

Information in Appendix A was abstracted from the Inventories of Potential and Existing Upstream Reservoir Sites prepared by the Soil Conservation Service in cooperation with the Massachusetts Water Resources Commission. Data is based on reconnaissance level investigations, and much more detailed investigations are needed before any of the sites could be developed as a municipal water supply storage.

Communities in need of water supply are encouraged to study the possibilities offered by these potential reservoir sites and to take the necessary acquisition or zoning steps to protect suitable sites from development.

8.8 RECREATION ALTERNATIVES

The Pilgrim Resource Conservation and Development Area Plan of Action contains 26 "Public Water-Based Recreation and Fish and Wildlife Development" opportunities including 19 "Environmental Corridors" along rivers in the southern portion of the Coastal Region. Environmental Corridors have been proposed for the streams indicated in Table 8.3.

TABLE 8.3 - PROPOSED RC&D ENVIRONMENTAL CORRIDORS

Chartley Brook	Shingle Island and Copicut Rivers
Nemasket River	Forge and Taunton Rivers
Philips Brook	Town Brook
Schumatuscacant River	Lower Taunton River
Cole River	Threemile River
Lee River	North River
Runnins River	Parkers River
East Branch of Westport River	Lower Weweantic River
Paskamanset River	Mashpee River
Herring River	

The corridors have a variety of purposes including fish habitat improvement, improved water quality, nature study, proper land use, educational value, as well as passive and active recreation.

Planning and implementation of these environmental corridors is a suitable alternative to meet needs for canoeing, hiking, and picnicking.

The 1975 SCORP report identified 16 Coastal Region rivers which have potential for development as canoe trails. These rivers, identified in Table 5.26 of the report, are suitable alternatives to meet identified needs for canoeing in the region.

The North River, South River, Taunton River, and Ipswich River were also identified in SCORP as having potential under the Massachusetts Scenic and Recreational Rivers Act. Early implementation of the act is needed to protect the rivers and their banks from degradation. With protection, the rivers will be able to continue to provide passive recreational opportunities.

All three of these alternatives (environmental corridors, canoe trails, and scenic and recreational rivers) require a minimum of financial investment. The environmental corridors offer an opportunity for civic group and community involvement with cleanup along the shores. Canoe trails and the Recreational and Scenic Rivers Act will preserve existing conditions and maintain these important resources in the public view, while plans are made to develop passive recreation potential.

TABLE 8.4 COMPARISON OF ALTERNATIVES AND NEEDS

National Objective	Study Concern	Alternatives	Comparison with Needs
NED	Land Use Agricultural Land	1-1 Ignore situation and continue to let market forces operate to the demise of the agricultural sector.	1. Would not generate any positive solution to expressed needs.
NED	Land Use Agricultural Land	1-2 Undertake a multi-faceted program whereby state and local officials, public and private institutions would actively press for public programs to preserve agricultural land by keeping land in agricultural production. a. Identify sources of comparative disadvantages and develop public policies and programs to minimize the disadvantages wherever possible. b. Complete soil surveys to determine most feasible locations of future developments while prohibiting their location on productive agricultural lands. c. Form task force to determine negative impacts of presently enacted and future legislation upon the agriculture sector and revise such legislation to minimize adverse impacts. d. Form task force to actively seek public programs to provide incentives for food and fiber processing and marketing firms to locate in the region. e. Form research task force to develop or locate new crops, crop and livestock products which could be produced in the region and thereby increase diversity of production.	1. Would have a positive impact in that 6,574 acres of agricultural land with production valued at $1,181,216 (1967 constant dollars) would be preserved and would meet the expressed need of maintaining the agricultural lease. a. Would increase economic viability and thereby contribute to reversing trend of agricultural land loss. b. Would minimize adverse impacts of development upon agriculture and would contribute to EQ needs as well. c. Would potentially help to minimize the impact of some ordinances (e.g., zoning ordinances) that promulgate specific goals but create incentives which are in opposition to those goals. d. Same as a. above. e. Same as a. above.
NED & EQ	Land Use Forestland	1-3 Increase management of public and private land by increasing personnel working on state land and personnel providing technical assistance to private landowners.	1. Will meet about 14 percent of the 1990 needs for wood products. 2. Increase the acres managed by about 36 percent. 3. Adequately meets the need for technical assistance on urban forest management.

TABLE 8.4

COMPARISON OF ALTERNATIVES AND NEEDS

National Objective	Study Concern	Alternatives	Comparison with Needs
NED	Land Use Forestland	1-4 Increase incentives to landowners to encourage them to manage their forestland for timber.	1. Will meet about 36 percent of the 1990 needs for wood products. 2. Increase the acres presently managed by about 89 percent. 3. Will meet the need for increased incentives in the area.
NED	Land Use Forestland	1-5 Establish a program to develop diversified markets for low quality products.	1. Will meet about 16 percent of the 1990 needs for wood products. 2. Increase the acres presently managed by about 40 percent. 3. Over a period of time this program will meet nearly all the needs for diversified markets.
NED & EQ	Land Use Forestland	1-6 Establish an information and education program to inform private landowners about the benefits of forestland management.	1. Will meet about 8 percent of the 1990 needs for wood products. 2. Increase the acres presently managed by about 19 percent. 3. Adequately meet the needs for knowledge on forestland management. 4. Adequately meets the need for knowledge on urban forestland management.
NED	Flooding	2-1 Nonparticipating cities and towns participate in the HUD Flood Insurance Program.	1. Limits future development of flood-prone areas and encourages communities to consider flood hazards when planning growth.
NED	Flooding	2-2 Implement structural measures to reduce flood damage in the following subwatersheds: IP-4, NS-5, NS-6, NE-22, and TA-56.	1. Reduces average annual flood damage from $351,000 to $152,000.
NED	Flooding	2-3 Implement floodproofing measures to reduce flood damage in the following subwatersheds: IP-4, NS-5, NS-6, NS-8, NE-19, NE-20, NE-22, SS-24, TA-52, TA-54, TA-56, and BB-45.	1. Reduces average annual flood damage from $493,000 to $205,000.

TABLE 8.4 COMPARISON OF ALTERNATIVES AND NEEDS

National Objective	Study Concern	Alternatives	Comparison with Needs
NED	Flooding	2-4 Implement a combination of structural and flood-proofing measures to reduce flood damage in the following subwatersheds: NS-5, NS-6, NE-22, TA-54, and TA-56.	1. Reduces average annual flood damage from $238,000 to $83,000.
EQ	Erosion and Sediment	3-1 Establish erosion and sediment control ordinances in municipalities with the most potential for urban development.	1. Reduces erosion on the 9,500-acres per year undergoing urbanizing development.
EQ	Erosion and Sediment	3-2 Establish a project measure in The Pilgrim RC&D Area to inventory all critical areas. Stabilize problem areas, using technical and financial assistance through the RC&D project.	1. Reduces erosion from the critical erosion areas of nearly two-thirds of the region.
NED	Erosion and Sediment	3-3 Inventory farmland erosion. Establish priority areas for installation of erosion control measures. Encourage and assist high priority landowners to solve cropland erosion problems. Increase cost-sharing for erosion measures.	1. Places increased SCS Conservation Operations Program and ASCS cost-sharing emphasis on cropland erosion practices.
EQ & NED	Wetlands	4-1 Accelerate wetlands acquisition programs to acquire an additional 20,000 acres of regionally important wetlands.	1. Reduces projected wetland loss. 2. Provides public access to inland wetlands for passive recreation.
EQ	Wetlands	4-2 Accelerate the Inland Wetlands Restriction Program.	1. Reduces projected wetland losses.
EQ & NED	Wetlands	4-3 Expand conservancy zoning for wetland areas.	1. Reduces projected wetland losses. 2. Provides additional protection to the 80,930-acres of inland wetlands which are not protected by public ownership, or the Inland Wetland Restriction Act.
EQ	Water Quality	5-1 Obtain detailed soil surveys and use them to guide growth in the following communities: Chatham, Eastham, Edgartown, Gay Head, Lynnfield, Middleton, Oak Bluffs, Provincetown, Reading, Saugus, Tisbury, Wellfleet	1. Reduces the potential harmful effects on water caused by malfunctioning septic tank systems located in unsuitable soils. 2. Has benefits in the area of land use by directing development away from "sensitive areas." 3. Has benefits in land use (agricultural land) by identifying prime agricultural land and land of state and local importance for farming.

TABLE 8.4

COMPARISON OF ALTERNATIVES AND NEEDS

National Objective	Study Concern	Alternatives	Comparison with Needs
NED	Water Supply	6-1 Communities investigate water supply opportunities offered by the 33 reservoir sites identified in Appendix A.	1. Identified reservoir sites have potential to supply nearly 48 million gallons per day of safe yield.
NED	Water Supply	6-2 Potential reservoir sites which can meet community water supply needs are acquired or otherwise protected from development which would make them unavailable or prohibitively expensive when needed as water supplies.	1. Reservoirs which have potential to meet a specific community need for water supply will be available when needed.
NED & EQ	Recreation	7-1 Establish environmental corridors along 19 selected streams in the region.	1. Provides passive recreation opportunities. 2. Increases public awareness of environmental resources.
NED	Recreation	7-2 Establish canoe trails on 16 rivers in the region.	1. Provides opportunities for canoeing to meet identified needs.
NED & EQ	Recreation	7-3 Implement the Massachusetts Scenic and Recreational Rivers Act for four of the region's rivers.	1. Protects a potential recreation resource from degradation or loss. 2. Increases public awareness of environmental resources. 3. Provides potential passive recreation opportunities.
NED & EQ	Recreation	7-4 Establish regional programs for protection of unique natural areas.	1. Increase public awareness of environmental resources. 2. Protects passive recreation resources.

8.9 ALTERNATIVE ACCOUNTS DISPLAY

The Water Resources Council's Principles and Standards for Planning of Water and Related Land Resources require that a system of information accounts be established to display beneficial and adverse effects of each alternative proposed to meet an objective. The effects of each alternative on national economic development, environmental quality, regional development, and social well-being are indicated to provide a basis for comparing alternatives. The purpose is to display beneficial and adverse effects so that different levels of achievement of each objective and trade offs between alternatives can be discerned and compared. Table 8.5 presents the Alternative Accounts Display.

TABLE 8.5

ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
1-Land Use 1-1 Agricultural Land - continue present land policies.	Beneficial Effects Minimizes public costs relative to preservation programs. Adverse Effects Projected loss of 6,574 acres resulting in a decrease of $1,181,000 in agricultural production.1/ Pro-rated cost of administering zoning ordinances. Loss of tax revenue from agricultural-horticultural assessments.	Beneficial Effects Continuing loss of agricultural land will decrease amounts of herbicides, pesticides and fertilizer nutrient entering water resources through runoff. Less erosion and sedimentation resulting from less land being cultivated. Adverse Effects Less diversified land use mix, thus lowering the aesthetic quality of the region. Adverse impact upon wildlife feeding habitat through a decrease in boundary areas of open and forestland.	Adverse Effects Adverse to the extent that loss of agricultural production (amounting to $1,181,000 from 6,574 acres) results in loss of input and output agricultural service and marketing facilities.2/	Adverse Effects Decrease in agricultural land decreases the aesthetic qualities of the area. Increase in food costs to extent of increased transportation charges for increased food imports.

1/ Approximate agricultural valuations (state averages) were computed by Dr. E. Engle, Department of Food and Resource Economics; University of Massachusetts (1974) for eight categories of agricultural land. Shade tobacco and nurseries: $480-720/acre; binder tobacco, vegetables, potatoes: $150-230/acre; cropland, pasture (tillable: $110-170/acre; orchards: $160-240/acre; cranberry bogs: $560-840/acre; untillable permanent pasture: $40-60/acre; farm woodland: $20-30/acre; nonproductive farm woodland: $5-7/acre.

2/ Loss of acreage was multiplied times average value of production per acre and expressed in 1967 dollars.

TABLE 8.5 ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
1-Land Use 1-2 Agricultural land - preserve or increase existing quantities of agricultural land.	Beneficial Effects Net earning and subsequent tax revenues that would be lost without preservation - $1,181,000. Food cost savings to extent that decrease in food products would be imported from other areas, thus increasing food prices. Adverse Effects Costs of preservation measures more expensive than present policies.1/ A. Purchase lease-back program: Initial cost of purchase ($600-$3,000 per acre) minus revenues derived from renting to agricultural entrepreneurs. B. Development Rights Program: Cost of Purchasing Development Rights.	Beneficial Effects Benefit would be derived to the extent that preservation of agricultural land would enhance the aesthetic qualities of diversified land use mix. Maintaining agricultural land would preserve boundary areas which would enhance wildlife habitat. Adverse Effects Increases pesticide, herbicide and other residues entering water areas through runoff has a detrimental impact on environmental quality. Increased erosion and sedimentation resulting from cultivating preserved acreage.	Beneficial Effects Benefits accrue to the extent that rates of unemployment and underemployment fall relative to such rates if land were not preserved. Much tourism due to aesthetic qualities which are enhanced through the maintenance of a diversified land use mix. Benefits accrue to the extent that agricultural land enhances the tourist industry. Adverse Effects One potential adverse impact stems from the development that would occur on the preserved acreage without a preservation program and that which would not occur with a preservation program. Although there is enough developable land in the region, even with a Preservation Program, added costs of developing nonpreserved land may result in some firms locating elsewhere.	Beneficial Effects Social well-being is enhanced to the extent that preservation measures enhance the aesthetic qualities of the region. To the extent that preservation measures result in lower food prices than would exist without a Preservation Program, SW-B is increased. Adverse Effects To extent society is adversely effected by noise and smells of agricultural production.

1/ Values of agricultural land in the region are dependent upon provision of roads, water, sewer, electricity and physical characteristics. A purchase lease-back program would involve a $600-$3,000 range. Prices that would be relevant for a Development Rights Program would be to determine an acceptable rate of return per acre and from that determining the capital cost of purchasing that land based on an acceptable return and subtracting the capital cost/acre from the market value of the land. This program is further complicated by the fact that, although almost all agricultural land is zoned residential, much land would not be developed due to location of flood plains, wetlands, and/or the physical characteristics of the land itself. Thus, under these circumstances, prices of development rights would be negligible.

TABLE 8.5 ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
1-Land Use 1-3 Increase management of public and private land by increasing personnel working on state land and personnel providing technical assistance to private landowners.	Beneficial Effects Sawtimber-900,000 c.f./yr. valued at $466,000 Pulpwood-430,000 c.f./yr. valued at $95,460 Recreation General-1,000,000 V.D./yr.1/ valued at $2,000,000 Recreation Special-1,600,000 V.D./yr. valued at $7,950,000 Water-6700 A.F. valued at $17,000. Adverse Effects Variable costs-$357,000/yr. Implementation costs-$39,000.	Beneficial Effects Increase in technical services for urban forest management. Improvement in wildlife habitat by creating a more diverse forest cover. Increased management and protection enhances the benefits provided by forestland. Increase in technical assistance insures the protection of the quality of soil, water and aesthetics. Adverse Effects Increase sediment yield by 18.5 tons/yr.	Beneficial Effects Increase employment by hiring 8 professionals, 8 technicians and 17 woods workers. Increase in cut provides additional wood for presently under-utilized mill capacity; provides increase in income to loggers and mills from additional wood; provides increase in revenues from tourism. Increase in industry employment because of increase harvest. Increase in recreational employment because of increase in visitor days.	Beneficial Effects Increased employment from more state, industry and recreational employment.
1-4 Increase incentives to landowners to encourage them to manage their forestland for timber.	Beneficial Effects Sawtimber-1,100,000 c.f./yr. valued at $570,000 Pulpwood-2,000,000 c.f./yr. valued at $440,000 Recreational General-46,500 V.D./yr. valued at $93,000 Recreation Special-1,200,000 V.D./yr. valued at $5,900,000. Adverse Effects Variable Costs-$115,000/yr. Implementation costs-$10,000.	Beneficial Effects Increase in forest management promotes and enhances benefits derived from forestland for now and in the future. More forestland managed decreases loss to urban development. Decreases sediment yield by 70 tons/yr.	Beneficial Effects Increases in regional income due to increase timber harvesting and recreation V.D. Enhances future employment because of increased forest productivity.	Beneficial Effects Increases the present and future employment.

1/ V.D. = Visitor Days.

TABLE 8.5

ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
1-Land Use 1-5 Establish a program to develop diversified market for low quality products.	Beneficial Effects Sawtimber-500,000 c.f./yr. valued at $265,000 Pulpwood-1,000,000 c.f./yr valued at $220,000 Recreation Special-1,200,000 V.D./yr valued at $2,400,000 Water-34,000 A.F. valued at $85,000 Adverse Effects Variable Costs-$204,000/yr. Implementation Costs-$1,500,000.	Beneficial Effects Increase in utilization promotes increase in wildlife habitat and provides better forest management practices. Provide market for forest products from land clearing, decreases burning and land fills. Adverse Effects Increases sediment yield by 21 tons/yr.	Beneficial Effects Increase in employment dependent upon plant size. Addition of two professionals to state employment. Adverse Effects Implementation cost of $1,500,000 by private industry. Annual operating cost of $150,000.	Beneficial Effects Increased employment from industry and state. Increased recreation close to urban centers.
1-6 Establish an information and education program to inform private landowners about the benefits of forestland management.	Beneficial Effects Sawtimber-460,000 c.f./yr. valued at $240,000 Pulpwood-230,000 c.f./yr. valued at $51,000 Recreation General-735,000 V.D./yr. valued at $1,470,000 Recreation Special-1,018,000 V.D./yr valued at $5,000,000 Water-36,000 A.F./yr valued at $90,000 Adverse Effects Variable Cost-$72,000/yr.	Beneficial Effects Provide information to urban forest landowners on management opportunities. Urban forestry technical assistance will help make development of forestland more environmental and aesthetically sound.	Beneficial Effects Increase income to area by increasing visitor days, valued at $9,000,000. Increased income from an increase in employment from more recreation and timber harvesting.	Beneficial Effects More aesthetic urban environment Increased employment. Increase in recreational opportunities close to urban centers.

TABLE 8.5 ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
2-Flooding 2-1 Nonparticipating cities and towns participate in the HUD Flood Insurance Program. Joining the program entails establishing effective flood plain restrictions; such as, zoning, subdivision controls and building regulations for development within the flood plains.	Beneficial Effects Prevents increases in damageable properties. Adverse Effects $125,000 initial cost of program. $4,000 per year for operation and management of program.	Beneficial or Adverse Effects Renewable resource lands (flood plains) protected as a result of required land use regulations. Tends to maintain existing water quality by preventing building development close to streams. Maintenance of streamsite habitats minimizes hazards to endangered species of animals, fish and plants.	Beneficial Effects Prevents increases in damageable properties. Prices of buildable land may go up, thus increasing property values. Adverse Effects Flood plain land no longer available for residential, commercial or industrial use. Prices of buildable land may go up which may adversely effect industrial and commercial activity. $2,500 per year for regional operation and management costs of program.	Beneficial or Adverse Effects Psychological satisfaction from the action. Program will help maintain present neighborhood character in vicinity of flood hazard areas. Remaining uplands will be subject to accelerated neighborhood change. Present landowners may face loss of property value due to program. Provides an equitable distribution of flood hazard risks.
2-2 Implement structural measures. A program of structural measures is economically feasible in the following subwatersheds: IP-4, NS-5, NS-6, NE-22 and TA-56.	Beneficial Effects Average annual flood damage will be reduced by $199,000. Adverse Effects Average annual cost is estimated to be $44,000.1/	Beneficial or Adverse Effects Irreversible commitment of land for program measures. Streams altered for project measures.	Beneficial Effects Developed land no longer subject to flooding from 100-year storm. Average annual damage will be reduced by $199,000. Creates 20 man years semi-skilled employment. Adverse Effects Local average annual cost is estimated to be $5,000.	Beneficial or Adverse Effects Reduce health and safety hazards associated with flooding. Psychological satisfaction from the action. Some landowners may be adverse to the action. Creates 20 man years semi-skilled employment.

1/ Discount estimated evaluation period.

TABLE 8.5 ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
2-Flooding 2-3 Implement floodproofing measures. A program of floodproofing existing structures is economically feasible in the following subwatersheds: IP-4, NS-5, NS-6, NS-8, NE-19, NE-20, NE-22, SS-24, TA-52, TA-54, TA-56, BB-45.	Beneficial Effects Average annual flood damage will be reduced by $288,000. Adverse Effects Average annual cost is estimated to be $60,000.	Beneficial or Adverse Effects May adversely effect appearance of some existing structures.	Beneficial Effects Average annual damage will be reduced by $288,000. Will create 25 man years semi-skilled employment. Adverse Effects Local average annual cost is estimated to be $55,000.	Beneficial or Adverse Effects Reduces health and safety hazards associated with flooding. Psychological satisfaction from the action. Some landowners may be adverse to the action. Will create 25 man years semi-skilled employment.
2-4 Implement both structural measures and flood proofing. A program combining structural measures with floodproofing is economically feasible in the following subwatersheds: NS-5, NS-6, NE-22, TA-54, and TA-56.	Beneficial Effects Average annual damage will be reduced by $155,000. Adverse Effects Average annual cost is estimated to be $49,000.	Beneficial or Adverse Effects Irreversible or irretrievable commitment of land for program measures. Stream channel altered for project measures. May adversely effect the appearance of some existing structures.	Beneficial Effects Average annual damage will be reduced by $155,000. Developed land no longer subject to flooding from 100-year storm. Will create 20 man year semi-skilled labor. Adverse Effects Local average annual cost is estimated to be $7,500.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some landowners may be adverse to the action. Will create 20 man years semi-skilled labor. Reduces health and safety hazards associated with flooding.
3-Erosion & Sediment 3-1 Establish erosion and sediment control ordinances in municipalities with the most potential for urban development.	Beneficial Effects 25,000 tons/yr. sediment damage reduction. Adverse Effects $75,000 initial capital cost to initiate program. Two man years to manage program.	Beneficial or Adverse Effects Reduce erosion on 9,400 acres/year of construction sites. Eliminate 25,000 tons/yr. of construction site produced sediment. Improvement of water quality downstream.	Beneficial Effects Adverse Effects	Beneficial or Adverse Effects Will increase cost of developing land for urban purposes.

TABLE 8.5 ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
3-Erosion & Sediment 3-2 Establish a project measure in The Pilgrim Area RC&D project to: - Inventory and map all critical areas and problem streambanks. This inventory to be repeated at 5 year intervals. - Stabilize these problem areas with technical and financial assistance provided through the RC&D project.	Beneficial Effects $200,000 per year sediment damage reduction. Adverse Effects $175,000/year cost of program.	Beneficial or Adverse Effects Reduce erosion on critical erosion problem areas and problem streambanks. Eliminate sediment from these sources. Improve stream water quality.	Beneficial Effects Will create 40 semi-skilled jobs for 1 year. Adverse Effects	Beneficial or Adverse Effects Will create 40 semi-skilled jobs for 1 year. Psychological satisfaction from the action.
3-3 Inventory cropland erosion problems. Establish priorities for assistance in the planning and installation of erosion control practices.	Beneficial Effects Productivity of farmland is maintained.	Beneficial or Adverse Effects Reduces potential sediment reaching watercourses.	Beneficial Effects Productivity of farmland is maintained.	Beneficial or Adverse Effects
4-Wetlands 4-1 An accelerated acquisition program to acquire an additional 20,000 acres (20,800 acres are expected to be acquired under ongoing programs) of regionally important wetlands.	Beneficial Effects Will contribute to meeting recreational and educational needs. Tends to maintain recreational quality of 20,000 acres. Adverse Effects Average annual cost is estimated to be $900,000.	Beneficial or Adverse Effects Will tend to preserve existing wildlife habitat. May preserve environmentally unique and valuable areas. Irreversible commitment of 20,000 acres prevented. Tends to maintain existing water quality. Tends to maintain low flow regime.	Beneficial Effects Will contribute to meeting recreational and educational needs of region. Adverse Effects Average annual cost is estimated to be $900,000. Prices of buildable land may increase and adversely effect economic activity. Decrease property tax base. Initial capital cost is estimated to be $15,000,000.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some resource owners may be adverse to the action.

TABLE 8.5 ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development (NED)	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
4-Wetlands 4-2 Accelerate Inland Wetland Restriction Program.	Beneficial Effects Will contribute to meeting recreational needs. Adverse Effects Annual cost is estimated to be $250,000.	Beneficial or Adverse Effects May lead to preservation of environmentally unique and valuable areas. Will tend to preserve existing wildlife habitat. Tends to maintain existing water quality.	Beneficial Effects Adverse Effects Annual cost is estimated to be $250,000.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some resource owners may be adverse to the action.
4-3 Expand Conservancy Zoning for wetland areas.	Beneficial Effects Discourages improper land use of wetlands.	Beneficial or Adverse Effects Will tend to preserve existing wildlife habitat. May preserve environmentally unique and valuable areas. Irreversible commitment of 35,000 acres prevented. Tends to maintain existing water quality Tends to maintain low flow regime.	Beneficial Effects Adverse Effects Initial capital cost is estimated to be $50,000. Prices of buildable land may increase and adversely effect economic activity. Decrease property tax base.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some resource owners may be adverse to the action.
5-Water Quality 5-1 Obtain detailed soil surveys and use them to aid in guiding growth in the following communities: Chatham, Eastham, Edgartown, Gay Head, Lynnfield, Middleton, Oak Bluffs, Peabody, Plainville, Provincetown, Reading, Saugus, Tisbury, Wellfleet	Beneficial Effects Assists in determining least cost alternatives to solving water quality problems. Adverse Effects Initial cost is estimated to be $180,000.	Beneficial or Adverse Effects Provides tool for maintaining present quality of all water and related land resources.	Beneficial Effects Will create 6 man years employment for a professional soil scientist. Adverse Effects Initial cost to towns within the region is estimated to be $90,000.	Beneficial or Adverse Effects Psychological satisfaction from the action. Provides basis for determining public health problems associated with water quality.

TABLE 8.5 ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
6-Water Supply 6-1 Investigate potential surface water reservoir sites for use as municipal water supplies.	Beneficial Effects Adverse Effects Cost of investigations.	Beneficial or Adverse Effects	Beneficial Effects More fully evaluates the potential of these reservoir sites.	Beneficial or Adverse Effects Provides community with sound data upon which to base future planning.
6-2 Acquire or otherwise protect suitable potential surface water reservoir sites.	Beneficial Effects Potential reservoir site is available when needed to provide water for economic growth. Adverse Effects Cost of land purchase or easements.	Beneficial or Adverse Effects Present land use is maintained. Future land use may change to open water.	Beneficial Effects Potential reservoir site is available when needed to provide for regional economic growth.	Beneficial or Adverse Effects Assures water supply for future needs.
7-Recreation 7-1 Establish environmental corridors.	Beneficial Effects Provides passive recreation opportunities. Adverse Effects Cost involved in implementing program.	Beneficial or Adverse Effects Increases public awareness of the resource.	Beneficial Effects	Beneficial or Adverse Effects Psychological satisfaction from the action. Some landowners may be adverse to the action.
7-2 Establish canoe trails.	Beneficial Effects Provides passive recreation opportunities. Adverse Effects Cost involved in implementing program.	Beneficial or Adverse Effects Increases public awareness of the resource.	Beneficial Effects	Beneficial or Adverse Effects Psychological satisfaction from the action. Some landowners may be adverse to the action.

TABLE 8.5

ALTERNATIVE ACCOUNTS DISPLAY

Alternative	National Economic Development	Environmental Quality (EQ)	Regional Development (RD)	Social Well-Being (SW-B)
7-Recreation 7-3 Designation of the following rivers as components of the Massachusetts Scenic and Recreational Rivers System (Mass. General Laws, Chapter 21, Section 17B). a. North River b. South River c. Ipswich River d. Taunton River	Beneficial Effects Positive step in initiating future alternatives of economic significance. Adverse Effects Average annual cost of administering and enforcing the program is estimated to be $3,000.	Beneficial or Adverse Effects Maintains present water quality. Insures preservation of stream character. Positive step in initiating future environmental alternatives.	Beneficial Effects Provides 1 skilled temporary part-time job. Adverse Effects Prices of buildable land may go up which may adversely effect industrial and commercial activity.	Beneficial or Adverse Effects Psychological satisfaction from the action. Some landowners may be adverse to the action. Provides 1 skilled temporary part-time job.

8.10 ENVIRONMENTAL IMPACTS

Table 8.6, Potential Environmental Impacts of Alternatives, summarizes the potential impacts that suggested alternatives may have upon fifteen key environmental factors. It also includes an assessment of the irreversible or irretrievable commitment of resources resulting from each alternative. Effects on air quality, migration routes, and archeological and historic resources were also considered. The alternatives are not expected to have a significant impact on air quality or migration routes. Archeological and historic resources cannot be assessed at this level of investigation. Structural alternatives, such as Alternative 6-2, surface water reservoirs for water supply, could result in an adverse impact upon archeological and historic resources. Such impacts would have to be evaluated during final planning stages.

Expected impact on each environmental factor is indicated by (x) when the alternative maintains or improves the situation; (-) when the alternative has a negative impact; and (0) when an alternative has both favorable and adverse impacts and/or has significant impacts, for which an adequate determination cannot be made at this time. No entry indicates that no significant impact is expected.

This table represents best judgement on possible effects based on all available information. It is expected that detailed planning of any alternative will investigate the significant environmental impacts indicated in this table.

TABLE 8.6 POTENTIAL ENVIRONMENTAL IMPACTS OF ALTERNATIVES

ALTERNATIVES	SIGNIFICANT ENVIRONMENTAL IMPACTS ON: 1/																	Irreversible & Irretrievable Commitment of Resources 2/
	Erosion & Sedimentation	Water Table Changes	Changes Flow Regime	Changes Land Use	Upland Wildlife Habitat	Bottomland WL Habitat	Bottomland Hardwoods	Stream Fisheries	Wetlands	Rare or Endangered Animals, Plants	Intermittent Streams	Perennial Streams	Water Quantity	Water Quality Incl. Receiving Water	Appearance of the Landscape	
1-1 Continue Present Agricultural Land Policies				0	-	-		0					0		-	+
1-2 Preserve Agricultural Land	0			+	+	+							0		+	+
1-3 Increase Forest Management	0						+						0	0	0	+
1-4 Increase Forest Management Incentives							+									+
1-5 Develop Diversified Timber Markets	0														0	+
1-6 Establish Information & Education Program							+									+
2-1 Flood Insurance	+		+	+		+	+	+	+			+	+	+	0	+
2-2 Structural Flood Protection Program	0	0	0	0	0	0	0	-	0			-	0	0	0	-
2-3 Floodproofing									0			-	+	0	0	-
2-4 Structural & Floodproofing	0	0	0	0	0	0	0	-	0			-	0	0	0	-
3-1 Erosion and Sediment Control Ordinance	+				+	+	+	+	+		+	+		+	+	+
3-2 RC&D Critical Area Restoration	+				+	+	+	+	+		+	+		+	+	+
3-3 Cropland Erosion Program	+												+	+		+
4-1 Wetlands Acquisition		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4-2 Accelerate Inland Wetlands Restrictions		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4-3 Expand Conservancy Zoning		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5-1 Soil Survey - 14 Towns	+	+		+	+	+	+	+	+		+	+	+	+	+	+
6-1 Investigate Potential Water Supplies																+
6-2 Acquire or Protect Water Supply Sites				+											+	+
7-1 Environmental Corridors	+			+		+			+	+		+	+		+	+
7-2 Canoe Trails												+	+			+
7-3 Massachusetts Scenic Recreation Rivers	+	+	+	+		+	+	+	+			+		+	+	+
7-4 Regional Protection of Unique Areas															+	+

1/ (+) Maintains or improves present situation. (-) Adverse impact expected. (0) Could have adverse and/or favorable impact. (Blank) no significant impact is expected.

2/ (+) No irreversible or irretrievable commitment of resources. (-) Involves an irreversible and irretrievable commitment of resources.



Plymouth County, Massachusetts: Massachusetts, the world's largest grower of cranberries, harvests its crops annually in September. The bogs are flooded in dry weather to protect the berries against insects and in the winter to protect the plants from freezing. The berries are packaged whole and processed into juices, sauces and jellies.

9 PROGRAM IMPLEMENTATION OF ALTERNATIVES

9.1 INTRODUCTION

This chapter identifies program opportunities available for implementing the Alternatives identified in Chapter 8. Existing federal, state, and local programs are outlined, which will enable the Alternatives to be turned into action. The ultimate result of the Massachusetts Water Resources Study is hopefully not a mere list of alternatives to meet needs but, rather, a catalyst for action designed to meet those needs.

9.2 OPPORTUNITIES FOR USDA PROGRAMS

A. Soil Conservation Service Programs

Resource Conservation and Development Program

The Soil Conservation Service is the lead USDA agency for The Pilgrim RC&D Area which has been established to "improve the quality of life in the area (Bristol, Plymouth, Dukes, Barnstable, and Nantucket Counties) through a coordinated effort to provide local decision-makers with technical information and financial aid for action-oriented measures, which seek to better utilize, manage, and protect the area's unique natural resources." The RC&D Area can provide financial and technical assistance measures for Critical Area Treatment for erosion and sediment control, Flood Prevention, Farm Irrigation, Land Drainage, Public Water-Based Recreation, and Fish and Wildlife Development, Soil and Water Conservation Management for Agriculture-Related Pollution Control, and Water Quality Management.

The RC&D Area could serve as a vehicle for implementing Alternative 2-2, Structural Flood Protection Program, for measures where social or economic benefits to the area will result. Up to one hundred percent federal cost sharing for technical assistance and structural measures for flood control is available. Local sponsors must provide all necessary land rights.

The RC&D Area could also assist in implementing Alternative 1-5, Establish a Program to Develop Diversified Markets for Low Quality Products.

The Critical Area Inventory, Alternative 3-2, could also be implemented under the auspices of the RC&D Program. Technical assistance to assess the extent of the problem and financial assistance to correct critical erosion areas is available. Up to 75 percent federal cost sharing is available to install corrective measures. Local sponsors must provide needed land rights and 25 percent of the project installation costs.

Establishment of Environmental Corridors, Alternative 7-1, along the streams of The Pilgrim Area are listed as RC&D Area measures. Technical assistance to plan and implement the corridors is available.

Conservation Operations Program

This is the ongoing program of the Soil Conservation Service. Technical assistance is available through the county conservation districts for the planning and installation of measures to develop and conserve natural resources. Field offices located in Littleton, Raynham, and Yarmouth Port provide this technical assistance in the Coastal Region.

Assistance is available to local communities in the establishment of Erosion and Sediment Control Ordinances (Alternative 3-1). Sample by-laws have been developed by the National Association of Conservation Districts and governmental research agencies. Communities can also utilize the ordinances of nearby communities for guidance. Personnel from the Soil Conservation Service can assist towns in recognizing the special erosion needs of their particular community.

Technical assistance is available to the conservation districts to prepare the Inventory of Cropland with Serious Erosion Problems (Alternative 3-3). Technical assistance is also available to landowners desiring to reduce erosion losses through the utilization of conservation practices.

Soil Survey Program

Soil Surveys conducted by the Soil Conservation Service include the mapping, classification, correlation, and interpretation of soils according to national standards. Soil mapping has been completed for much of the Coastal Region (See Figure 5-17). Communities may accelerate the completion of mapping by sharing the cost of soil surveys within the town boundaries. The soil survey program of the Soil Conservation Service can be used to implement Alternative 5-1.

Soil surveys are an essential element of basic data in the identification of prime agricultural land and are a first step in any program to protect prime agricultural land from urban development. Alternative 1-2, Preserve Agricultural Land, will rely on accurate soil survey data being available.

Public Law 83-566

The Small Watershed Protection and Flood Prevention Act provides technical and financial assistance to solve land and water problems. Flood prevention must be a major concern in each watershed.

Federal cost sharing is available to provide 100 percent of the cost of structural measures to provide flood protection, and 50 percent of the cost of multipurpose reservoir storage allocated to recreation or fish

and wildlife developments. Non PL-566 cost sharing must be provided by local sponsors who must also provide all necessary land rights needed for project installation.

At the present time, federal cost sharing for nonstructural or flood-proofing methods of reducing flood damage is not available under PL-566 or other federal flood protection programs. PL-566 can, however, assist local communities to develop plans for nonstructural flood protection, if this is the most feasible and acceptable alternative. All installa-ion costs must be borne by non PL-566 funds.

The structural measures studied for each watershed with significant damage predominantly include the use of floodwalls or earthen dikes to provide flood protection to an industry or business that sustains major damage. In many cases, residential damage remains, since there is no feasible system of protecting this property in most of the watersheds. Reservoir sites have been encroached upon or have been completely developed with buildings. In other cases, the flat topography limits the number of potential flood prevention sites. In the areas with a large percentage of upstream wetlands, peak flood flows are often below the minimum release rates required for design of a floodwater retarding structure.

Public Law 83-566 requires that needed structural works of improvement not be single purpose local flood control measures or water development projects which could be more appropriately carried out with federal assistance provided under other authorities. This is the case for many of the strictly structural alternatives which protect the major damage area, usually an industry located along the banks of the river.

PL-566 can, however, be utilized to plan and implement multiple-purpose projects and local protection measures combined with other water resource development.

Massachusetts Natural Resources Planning Program (MNRPP)

This local initiative program enables communities to inventory their natural resources, to rate those resources against standards, and to determine the consequences of proposed actions on the natural resource base. A Regional Technical Team is available to assist the townspeople to assess their resources and problems. Graduate student interns work with local residents to collect and analyze data.

The Massachusetts Natural Resources Planning Program is a useful tool in assessing the magnitude of resource problems and in developing courses of action to solve the problems. Preservation of Agricultural Land (Alternative 1-2), Critical Area Inventories (Alternative 3-2), Wetlands Acquisition (Alternative 4-1), Conservancy Zoning (Alternative 4-3) and Environmental Corridors (Alternative 7-1) should all be more easily implementable in a town participating in the Massachusetts Natural

Resources Planning Program. Basic inventories needed for the program and the increased public awareness of the natural resource base will be useful in laying the foundations for implementation of alternatives.

B. Forest Service Programs

Renewable Resources Program

This is an "umbrella" program which combines many of the Forest Service authorities into a unified group of systems for recreation, wildlife, timber, land and water conservation, and human and community development. The Forest Service cooperates with the Massachusetts Department of Environmental Management, Division of Forests and Parks, to conduct forestry programs on state and privately owned forestland.

The Renewable Resources Program can provide assistance to forest landowners to Increase Management of Public and Private Forest Land (Alternative 1-3), assist in establishing a Program to Develop Diversified Markets for Low Quality Wood Products (Alternative 1-5), and to assist in the establishment of an Information and Education Program to Inform Landowners About Benefits of Forest Management (Alternative 1-6).

C. Farmers Home Administration (FmHA) Loans and Grants

The FmHA has a number of loan and grant programs designed to encourage the economic development of rural areas. These programs can be used by the region's rural communities to help implement alternatives.

Loans are available to assist sponsoring public agencies in Resource Conservation and Development Areas. Soil and water loans are designed to aid farm landowners to make better use of their farmland. Watershed Protection and Flood Prevention loans help PL-566 sponsors to provide the local cost of structural measures. In addition, loans and grants are available to improve rural water systems.

Farmers Home Administration loans and grants could assist in implementing Alternatives 1-1, 2-2, 2-4, 3-2, and 6-2.

9.3 OPPORTUNITIES FOR OTHER PROGRAMS

A. Federal Programs

National Flood Insurance Program

The Department of Housing and Urban Development, through the Federal Insurance Administration, provides communities with the opportunity to participate in the National Flood Insurance Program. Flood insurance is available through local agents for residents of towns which qualify for the program. In return for federally subsidized insurance rates, the

community must agree to consider flood hazards before approving development and to severely limit development of flood prone areas. All except ten of the Coastal Region communities are enrolled in the flood insurance program which implements Alternative 2-1, Flood Insurance.

Land and Water Conservation Fund

The Land and Water Conservation Fund administered by the U.S. Department of the Interior, Bureau of Outdoor Recreation, provides cost sharing assistance to finance recreation and open space programs. The Fund could assist in implementing Alternatives 4-1 and 7-1.

B. State Programs

Land Use

Recently enacted Chapter 780 of the Acts of 1977, Massachusetts General Laws, will be administered by the Division of Conservation Services working in cooperation with local Conservation Commissions. Starting with a pilot program, the Act will seek to halt the development of critical farmland through the purchase of development rights (Alternative 1-2).

The Horticultural Land Assessment Act under Chapter 61A of the General Laws can also be used in a multi-faceted approach to encourage the preservation of agricultural land use.

Forestry Programs

The Department of Environmental Management cooperates with the U.S. Forest Service to assist forest landowners to make the best use of the forest resource. This program can aid in the implementation of Alternative 1-3, Increased Management of Forest Land, and Alternative 1-6, Information and Education to Inform Forest Landowners of Benefits of Management.

The Forestland Assessment Act, General Laws, Chapter 61, can be used to maintain forestland in the face of rising real estate taxes, thus, helping to implement Alternative 1-4, Increase Incentives to Manage Forest Land.

Wetlands Programs

The Wetlands Restriction Section of the Department of Environmental Management administers the Wetlands Restriction Act. Increased staff or greater use of outside consultants will be necessary if Alternative 4-2, Accelerate Wetlands Restrictions, is to be accomplished.

The Massachusetts "Wetlands for Wildlife" program of the Division of Fisheries and Wildlife has purchased wetland areas in the region for their wildlife habitat value. This program can be utilized to implement

Alternative 4-1, Wetlands Acquisition. The Division of Conservation Services could assist municipalities to acquire and develop outdoor facilities through the Massachusetts Self-Help program.

Recreational Programs

The Department of Environmental Management is the agency which would be responsible for implementing the Massachusetts Scenic and Recreational Rivers Act (Alternative 7-3). The department has established a pilot program for the North River to gain experience in administering the act.

Alternative 7-2, Establishment of Canoe Trails, could also be administered under ongoing programs of the Department of Environmental Management.

The Massachusetts Self-Help Program can provide funds to assist in recreation and open space programs such as land acquisition to enhance Environmental Corridors (Alternative 7-1).

Reservoir Programs

The Division of Water Resources of the Department of Environmental Management has funds available from a bond issue to acquire and protect potential reservoir sites. These funds were utilized to investigate the feasibility of "Site #30-B" in Ipswich as a regional water supply reservoir. Funds may be available from this source to investigate and protect potential surface water reservoir sites (Alternatives 6-1 and 6-2).

The Massachusetts Self-Help Program can assist with acquisition of water supply sites and can also assist by acquiring conservation lands for future use as water impoundments (Alternative 6-2).

C. Regional Programs

Regional planning agencies are the logical group to assist communities to establish erosion and sediment control ordinances (Alternative 3-1). Technical assistance and guidance is available from the Soil Conservation Service through the local Conservation District. A number of "model" ordinances are available which can be adapted to fit local conditions.

The Martha's Vineyard Commission has initiated a program to protect unique natural areas. Many of the Commission's programs relate directly to the enhancement and/or preservation of fragile, unique, or agricultural lands. On the Vineyard, the Commission's regulatory powers can be useful in implementing Alternatives 1-2, 3-1, 4-3, and 7-4.

TABLE 9.1 - PROGRAM IMPLEMENTATION

ALTERNATIVE	DESCRIPTION	PROGRAM AND AGENCY																		
		Resource Conservation & Development Soil Conservation Service (lead USDA agency)	Conservation Operations Soil Conservation Service	Soil Survey Soil Conservation Service	PL-566 Soil Conservation Service	Natural Resources Planning Program Soil Conservation Service	Renewable Resources Program Forest Service	Loans and Grants Farmers Home Administration	National Flood Insurance Dept. of Housing & Urban Development	Forestry Programs Dept. of Environmental Management	Wetlands Restriction Program Dept. of Environmental Management	Recreation Programs Dept. of Environmental Management	Wetlands for Wildlife Dept. of Fisheries, Wildlife and Recreational Vehicles	Division of Conservation Services Programs	DWR Potential Reservoir Funds Dept. of Environmental Management	Regional Planning Agencies
1-2	Preserve Agricultural Land			X		X	X	X								
1-3	Increase Forest Management						X			X						
1-4	Increase Forest Management Incentives	X				X				X						
1-5	Develop Diversified Timber Markets					X				X						
1-6	Establish Information and Education Program								X							
2-1	Flood Insurance	X			X			X								
2-2	Structural Flood Protection				X											
2-3	Floodproofing				X			X								
2-4	Structural and Floodproofing		X								X					
3-1	Erosion and Sediment Control Bylaws	X				X		X								
3-2	Critical Area Restoration	X														
3-3	Cropland Erosion Program		X											X		
4-1	Wetlands Acquisition					X					X		X			
4-2	Accelerate Wetlands Restrictions															
4-3	Expand Conservancy Zoning					X										X
5-1	Soil Survey			X												
6-1	Investigate Potential Water Supplies														X	
6-2	Acquire or Protect Water Supply Sites							X							X	
7-1	Environmental Corridors	X				X						X		X		
7-2	Canoe Trails											X	X	X		
7-4	Protect Unique Natural Areas	X										X				



Plymouth, Massachusetts: Mayflower II is a replica of the ship that brought the Pilgrims to this Coastal Region town in 1620.

COASTAL REGION

APPENDIX A

Prime Potential Reservoir Sites

1. Summary

The potential reservoir sites which are presented in this appendix represent the prime possibilities for permanent water storage sites in the Coastal Region which are not already under active consideration for development. Topography, geology, and affected man-made facilities appear to be favorable. More detailed geologic and engineering investigations need to be made before sites are acquired. If future needs for a reservoir site in a particular area can be identified, steps should be taken to acquire the site at an early date so that development in the area does not make reservoir costs excessive. Early acquisition or protection of these potential reservoir sites is essential to conserve these important natural resources for future use.

2. Previous Studies

The Soil Conservation Service has completed and published inventories of potential reservoir sites in the Coastal Region. Reservoir locations were selected on the basis of suitable topography, relatively undeveloped pool areas, and certain drainage area, pool area, and storage characteristics. Inventory data which was prepared included a surficial geologic investigation, list of man-made facilities which would be inundated and preliminary designs and cost estimates for various levels of development.

The inventories provide a valuable source of basic information about more than 320 potential reservoir sites in the region. No attempt was made in the inventories to evaluate the potential of the sites for specific purposes such as water supply, recreation, etc. Unfortunately, many of the sites which first appear promising fail to meet the more stringent criteria required for a good water supply or low-flow augmentation reservoir. Among the more common problems are poor geologic conditions, recent development of the pool area, and extremely high cost.

3. Site Evaluation

The purpose of this appendix is the presentation of the most promising potential reservoir sites in the Coastal Region. Inventories of potential sites for the Ipswich, Neponset, Parker, North Shore, South Shore, Cape Cod, Buzzards Bay, Islands, Taunton, and Narragansett Bay Study Areas were used as the source of basic data. Many sites were quickly eliminated from

further consideration because of obvious problems connected with geologic conditions and extensive effects on man-made facilities. The relatively flat topography in the region also eliminated many sites; large shallow areas tend to produce poorer quality water supply than deep sites. Likewise, low-flow augmentation and recreation uses tend to favor the deeper pools. Several of the sites have already been selected for development and are in varying stages of planning, design, and construction. These include site "30B", the Beverly-Salem Water Board Reservoir and the Lynnfield Center Reservoir in the Ipswich Study Area; as well as the Diamond Brook reservoir in the Neponset Area.

The remaining sites were individually evaluated for potential uses. Table A-1 summarizes information for the sites which appear to have potential for permanent storage of water. More detailed information concerning the individual sites is available in the Inventory of Potential and Existing Reservoir Sites for the particular area.

4. Protection of Sites

These potential reservoir sites are an important natural resource. They are examples of unique situations combining suitable topography to provide efficient storage, good geologic conditions which limit excessive seepage losses, and relatively undeveloped, lower cost, reservoir areas. Many of the potential reservoir sites in Massachusetts have been lost for future utilization through poor or uninformed land use decisions. Residential and commercial development in the state has encroached on the potential reservoir area of a number of otherwise suitable sites. In many instances, wetland protection measures have been effective in preserving the stream and the adjoining wetlands. However, the higher nonwetland areas which would be needed to provide deep water storage potential have been subject to development with little restriction. As a result, a potential deep water storage site with good geology may be economically infeasible because of the high cost involved in removing encroaching development.

State and local governments must begin to recognize the importance of protecting this dwindling natural resource--the natural potential reservoir site--from loss through default. The result of inaction in this area will not be catastrophic. Loss of a potential reservoir site is a more subtle loss which may not become apparent for several years until needs for water supply or water-based recreation cannot be easily or economically met. Then it will become apparent that preservation of these sites would have been in the public interest. The purchasing of houses in a potential water supply reservoir is socially disruptive to a community as well as being highly expensive. Development in a potential recreation or fishing pool area usually represents the loss of the site as costs per surface acre become prohibitive. It would appear to be more prudent to establish a program of early acquisition of potential reservoir sites in order to safeguard the areas from development pressures.

A note of caution is necessary at this point. All of the data which has been prepared for the potential site inventories is based on preliminary data which should be substantiated and reinforced before site acquisition is undertaken. Among the most important items which need to be developed before acquisition is a detailed subsurface geologic investigation to ascertain the materials which are present. Analyses needs to be made of the potential for seepage into the ground water. Current appraisals of land costs by competent professionals are also needed.

If a future need for the site can be identified; and if the detailed studies show the site to offer practical potential, steps should be undertaken to limit unwise development of the area. Purchase of the site is one possibility. Acquisition of development rights is another. A third possibility might be donation of the land for conservation purposes by public-spirited citizens. Even if acquisition of a potential reservoir area does not appear feasible, governments can take steps to make development compatible with future use of the area. Highway locations can be realigned to skirt reservoir sites. Developers can be encouraged to keep potential pool areas as undeveloped green space to complement the developed areas. Town boards can avoid locating schools, sanitary landfills, and other municipal improvements on potential reservoir areas.

If steps are not taken to protect these potential reservoir sites from unwise or uninformed development, they will likely be too costly to acquire in the future. They will be lost for future reservoir use unless timely action is undertaken to protect and preserve them to meet anticipated needs.

TABLE A-1

PRIME POTENTIAL RESERVOIR SITES

Site	Town	Drainage Area (square miles)	Water Supply				Low Flow			Recreation	
			Elevation (mean Sea level)	Volume (million gallons)	Yield (million gallons per day)	Max. Depth (feet)	Elevation (mean sea level)	Volume (acre-feet)	Augmentation for 120 days (cu.ft. per second)	Elevation (mean sea level)	Area (acres)
SS-2603	Hingham	4.40	70	360	1.4	20	70	1,090	4.6	70	130
2703	Norwell	1.57	82	290	0.9	16	--	--	--	82	105
BB-4603	Westport	3.47	140	780	2.1	30	135	1,480	6.2	141	215
4604	Westport	3.34	73	700	1.9	41	--	--	--	73	140
IS-6904	West Tisbury	2.54	67	570	1.5	41	--	--	--	--	--
6905	West Tisbury	1.38	81	240	0.7	23	--	--	--	--	--
TA-4701	Easton	1.20	192	200	0.6	16	191	520	2.2	191	75
4804	Brockton	4.80	134	920	2.6	24	132	2,170	9.1	132	295
5401	Sharon	0.61	--	--	--	--	252	220	0.9	252	35
5407	Mansfield	1.29	--	--	--	--	192	250	1.1	192	50
5515	Wrentham	0.78	--	--	--	--	280	300	1.3	279	50
5516	Mansfield	19.46	152	280	1.6	20	152	860	3.6	152	200
5601	Norton	1.50	--	--	--	--	92	150	0.6	92	35
5802	Freetown	3.31	148	710	2.0	26	143	1,190	5.0	150	220
5804	Freetown	3.80	111	840	2.3	41	104	1,620	6.8	117	245
5805	Freetown	4.06	82	270	1.1	47	82	810	3.4	82	65
NB-5902	Rehoboth	5.26	108	1,100	3.0	36	103	2,100	8.8	107	330
5909	Rehoboth	5.77	70	910	2.8	26	69	2,350	9.9	70	365
6004	N. Attleborough	2.39	203	530	1.4	27	199	1,070	4.5	205	160
7204	Swansea	0.77	--	--	--	--	126	300	1.3	125	55
7205	Swansea	1.48	92	170	0.6	28	92	530	2.2	92	45
7206	Swansea	2.11	82	610	1.5	34	74	980	4.1	82	135
7207	Swansea	7.62	81	790	2.8	15	81	2,440	10.3	81	480
7208	Dighton	0.69	--	--	--	--	115	260	1.1	113	45

TABLE A-1

PRIME POTENTIAL RESERVOIR SITES

Site	Town	Drainage Area (square miles)	Water Supply				Low Flow			Recreation	
			Elevation (mean Sea level)	Volume (million gallons)	Yield (million gallons per day)	Max. Depth (feet)	Elevation (mean sea level)	Volume (acre-feet)	Augmentation for 120 days (cu.ft. per second)	Elevation (mean sea level)	Area (acres)
PA-0202	Newbury	0.54	--	--	--		27	240	1.0	27	30
0307	Newbury	1.43	30	310	0.9	22	--	--	--	26	85
0324	Georgetown	2.22	--	--	--		--	--	--	34	60
0327	Rowley	1.42	--	--	--		40	240	1.0	40	50
0328	Rowley	7.56	43	220	1.7	21	43	670	2.8	43	95
0329	Rowley	0.70	--	--	--		46	290	1.2	45	40
0330	Rowley	3.27	55	490	1.7	30	54	1,320	5.5	54	205
0331	Rowley	13.10	25	120	1.6	15	--	--	--	25	100
0333	Rowley	1.94	28	320	1.0	23	--	--	--	25	130
0337	Rowley	5.80	57	180	1.3	13	57	550	2.3	57	75
0509	Gloucester	0.58	--	--	--		--	--	--	142	35
0606	Salem	1.54	25	140	0.6	17	--	--	--	25	70
NE-1803	Sharon	0.72	--	--	--		--	--	--	264	30
1907	Canton	1.73	182	250	0.9	17	182	760	3.2	181	105
2005	Westwood	1.04	--	--	--		245	270	1.1	245	65
IP-0411	N. Reading	1.00	102	1,200	P.S.1/		--	--	--	--	--
0414	N. Andover	4.10	123	810	2.2	23	120	1,890	7.9	123	235
0416	Middleton	1.60	102	950	P.S.1/		--	--	--	--	--
0417	Middleton	10.70	73	820	3.3	25	73	2,510	10.6	73	340
0419	N. Andover	1.50	182	420	0.9	20	175	640	2.7	178	95
0423	Boxford	18.2	73	210	1.0	15	73	640	2.7	73	100
0459	N. Andover	0.70	192	450	P.S.1/	13	181	310	1.3	178	45

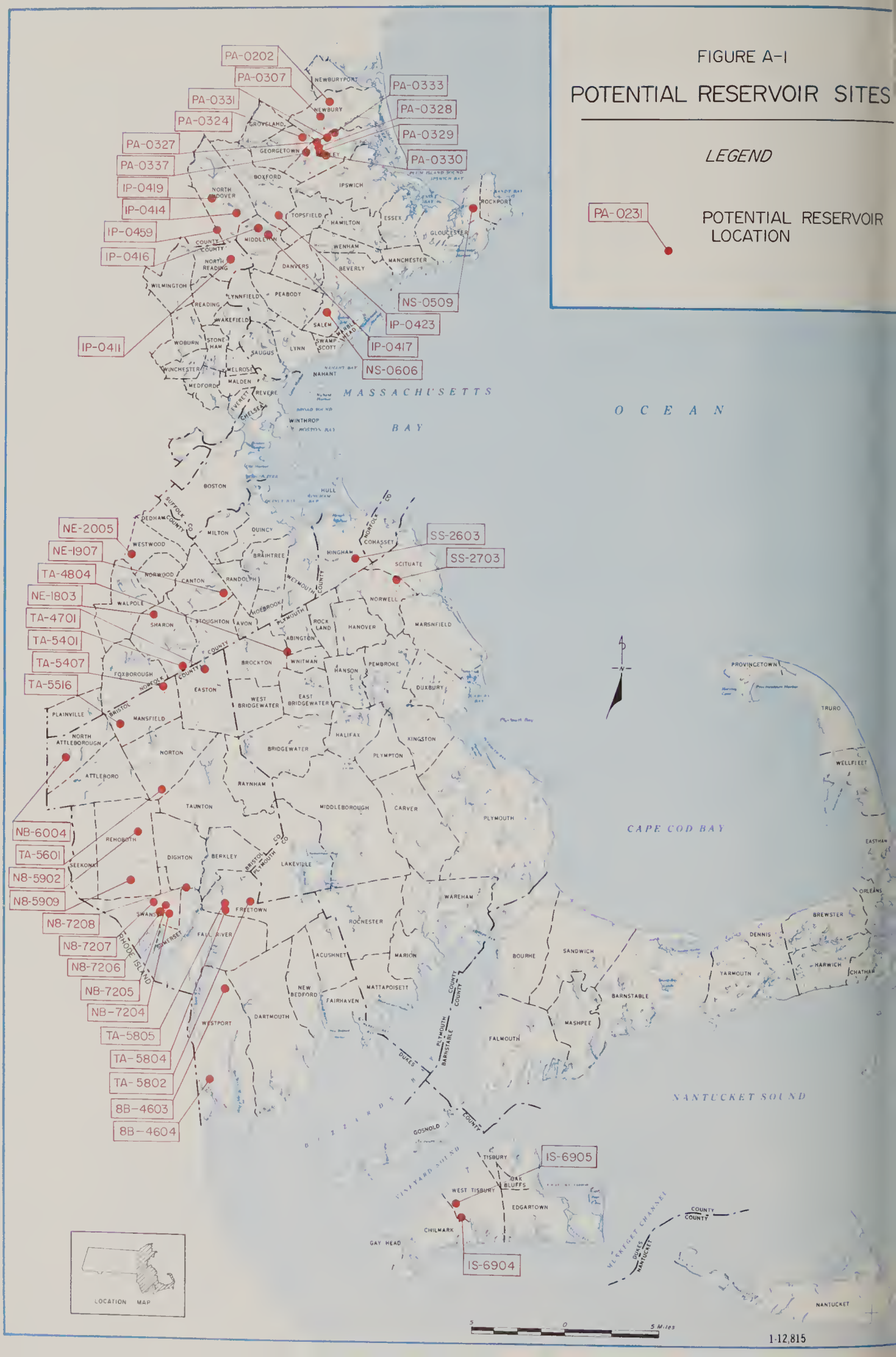
Levels of development presented in this table were selected to illustrate the maximum potential for each use.

Water supply is based on a safe yield of 0.6 million gallons per day per square mile of drainage area or the maximum safe yield of the site; whichever is less.

Low flow augmentation is based on 8 inches of runoff volume from the drainage area, or the maximum storage available at the site; whichever is less.

Recreation is based on the lesser of: the maximum surface area available at the site or, the surface area which is one-tenth of the drainage area size.

1/ This site has potential as a pumped-storage water supply facility. Safe yield will depend upon the source of pumped water, pumping period, land capacity of pumping equipment.


FIGURE A-1
POTENTIAL RESERVOIR SITES
LEGEND
PA-0231
POTENTIAL RESERVOIR LOCATION
PA-0202
PA-0307
PA-0331
PA-0324
PA-0327
PA-0337
IP-0419
IP-0414
IP-0459
IP-0416
IP-0411
PA-0333
PA-0328
PA-0329
PA-0330
NS-0509
IP-0423
IP-0417
NS-0606
NE-2005
NE-1907
TA-4804
NE-1803
TA-4701
TA-5401
TA-5407
TA-5516
SS-2603
SS-2703
NB-6004
TA-5601
N8-5902
N8-5909
N8-7208
N8-7207
N8-7206
NB-7205
NB-7204
TA-5805
TA-5804
TA-5802
8B-4603
8B-4604
IS-6905
IS-6904
MASSACHUSETTS BAY
OCEAN
CAPE COD BAY
NANTUCKET SOUND
BOSTON
NEWBURYPORT
NEWBURY
GROVELAND
GEORGETOWN
BOXFORD
IPSWICH
ROCKPORT
NORTH ANDOVER
TOPSFIELD
HAMILTON
ESSEX
GLOUCESTER
MIDDLETON
WENHAM
MANCHESTER
COUNTY
NORTH READING
DANVERS
BEVERLY
WILMINGTON
LYNNFIELD
PEABODY
READING
WAKEFIELD
SALEM
MARBLEHEAD
WOBURN
STONEHAM
SAUGUS
LYNN
SWAMPSCOTT
WINCHESTER
MELROSE
MALDEN
NAHANT
MEDFORD
REVERE
EVERETT
CHELSEA
WINTHROP
HULL
SUFFOLK CO
DEDHAM
MILTON
QUINCY
NORFOLK
COHASSET
WESTWOOD
BRAINTREE
HINGHAM
SCITUATE
NORWOOD
CANTON
RANDOLPH
WEYMOUTH
NORWELL
WALPOLE
HOLBROOK
PLYMOUTH
ROCKLAND
HANOVER
MARSHFIELD
SHARON
STOUGHTON
AVON
ABINGTON
BROCKTON
WHITMAN
HANSON
PEMBROKE
FOXBOROUGH
EASTON
DUXBURY
WEST BRIDGEWATER
EAST BRIDGEWATER
PLAINVILLE
BRISTOL
MANSFIELD
NORTH ATTLEBOROUGH
HALIFAX
KINGSTON
NORTON
BRIDGEWATER
PLYMPTON
ATTLEBORO
RAYNHAM
TAUNTON
MIDDLEBOROUGH
CARVER
PLYMOUTH
REHOBOTH
DIGHTON
BERKLEY
LAKEVILLE
SEEKONK
WAREHAM
SWANSEA
FREETOWN
ROCHESTER
FALL RIVER
SOMERSET
RHODE ISLAND
ACUSHNET
MARION
BOURNE
SANDWICH
NEW BEDFORD
FAIRHAVEN
MATTAPOISETT
BARNSTABLE
MASHPEE
FALMOUTH
DARTMOUTH
WESTPORT
DUKES
GOSNOLD
TISBURY
OAK BLUFFS
WEST TISBURY
EDGARTOWN
CHILMARK
GAY HEAD
PROVINCETOWN
TRURO
WELLFLEET
EASTHAM
ORLEANS
BREWSTER
DENNIS
YARMOUTH
HARWICH
CHATHAM
NANTUCKET
WESTERN CHANNEL
LOCATION MAP
5 0 5 Miles
1-12,815

APPENDIX B

Wetland Evaluation Criteria

This section contains the criteria used to evaluate major wetlands in the Coastal Region. Each of the 85 wetlands which was evaluated was subjected to map study and a field examination. Ratings were assigned based on point values obtained for various attributes. Rationale for each evaluation item is also contained in this appendix to explain the background concerning development of the criteria.

The wetland evaluation criteria were developed by an interdisciplinary team of USDA specialists. Draft criteria were circulated among federal, state and regional agencies for comments and suggestions.

The criteria, with modifications, may be helpful in assessing the smaller wetlands of a community. Development of the evaluation procedure was based upon a regional approach and certain criteria, such as size, may need to be altered to fit local situations. The numerical rating values might also need to be modified to account for factors which might be important from a local basis but insignificant on a regional scale.

WETLAND EVALUATION

Wetland Name _____ No. ____ Date_____

Wetland Location (City or Town) _____

Investigator _____

Ownership (Public - give name; or Private) _____

Size (acres) _____ Drainage System _____

Type Classification (acres per type) _____

_____

Surrounding Topography _____

Flora _____

_____

Fauna _____

_____

Current Use _____

Adjacent Land Use _____

Nearness to Houses, etc. _____

Potential Pollution Problem _____

Accessibility _____

Potential Storage Depth at Outlet _____ft. (vertical distance from normal water level to top of control structure)

Size of outlet structure if any _____

Rating Summary

Forest Management _____ Recreation _____

Flood Control _____ Uniqueness _____

Fish Habitat _____ Visual Quality _____

Wetland Wildlife Habitat _____

Comments

_____

_____

_____

_____

WETLAND EVALUATION

Wetland Name _____ No. _____

FOREST MANAGEMENT 1/

CRITERION		RANGE	Circle Correct RATING
1.	Public ownership of forested wetland	>30%	3
		15-30%	2
		<15%	1
2.	Stand size class distribution 2/ (sawtimber, poletimber, seedling-sapling)	<80% in any 2 classes	3
		>80% in any 2 classes	2
		>80% in any 1 class	1
3.	Portion of forestland with 81-100% crown closure	>80%	6
		30-80%	4
		<30%	2
4.	Portion of wetland forested	>60%	3
		30-60%	2
		<30%	1
5.	Predominant forest cover type	Cedar, red maple, larch/ tamarack or green ash	9
		Hemlock, black ash or black spruce	3
6.	Shape of forested wetland	Block	3
		Long narrow strip	1
7.	Type of soil	Mineral	6
		Peat	2
8.	Accessibility	Roads in wetland	6
		Roads leading to but not in wetland	4
		No roads leading to wetland	2
		Total circled items:	_____

RATING: Greater than 28 = High
24 to 28 = Moderate
Less than 24 = Low

Rating is: _____

1/Wetlands containing less than 5 acres of forest should not be rated. Insert NR in rating blank.

2/ If wooded areas are inaccessible for inspection MacConnell's height classes may be used:

Classes 1 & 2 Seedling-Sapling
Classes 3 & 4 Poletimber
Class 5 Sawtimber
Class 6 - rates high (3)

WETLAND EVALUATION

Wetland Name _____ No. _____

FLOOD CONTROL

CRITERION	RANGE		Circle Correct RATING
1. Effective storage of wetland on total watershed above.	<1" runoff		0
	1"-3" runoff		6
	>3" runoff		9
2. Effective storage of upstream reservoirs and wetlands on total watershed.	<1" runoff		3
	1"-3" runoff		2
	>3" runoff		1
3. Effective storage on main stem between wetland and Potential Damage Area or major confluence.	<1" runoff		8
	1"-3" runoff		4
	>3" runoff		0
4. Distance downstream to Potential Damage Area	<1 mile		3
	1-5 miles		1
	over 5 miles		0
5. Severity of Potential Flood Damage (downstream)	<3 miles	Low	2
		Moderate	4
		High	8
	or		
	3-5 miles or below major confluence	Low	1
		Moderate	2
		High	4

Total circled items: _____

RATING: Total is: Less than 15 = Low
15 to 23 = Moderate
24 or greater = High RATING is: _____

WETLAND EVALUATION

Flood Control

Instructions for Each Item on the Evaluation Sheet

1. The effective storage can be estimated by expected increase in wetland water elevation (a) during a large (approx. 100 year) flood times (x) the wetland area times (x) 12 divided by the drainage acres.

   $$\text{Effective Storage (in inches runoff)} = \frac{\text{Change in elevation} \times \text{wetland area} \times 12}{\text{drainage acres}}$$

   (a) Where there is a control at outlet of wetland, change in elevation will be estimated by field observation. Where there is no control, use attached curves.

2. Effective storage of upstream reservoirs and wetlands is estimated as under Item 1 and includes all storage in the drainage area above the wetland being evaluated, but not the wetland storage.

3. Effective storage on the main stem below the wetland being evaluated and the major part of the damage area. This is the storage of the downstream channel or wetland (inches) divided by the total drainage above the damage area (acres).

4. This is a visual estimate using aerial photos, quad sheets, personal knowledge or observation.

5. This is to be a comparison rating based on aerial photos, quads, personal knowledge and observation. Damage which might occur to that which replaces and surrounds the wetland should also be considered.

   Potential Damage: Low - agriculture, scattered residences, secondary roads
   Moderate - >low but <high
   High - concentrated residences, commercial, industrial, primary roads.

Limitation of Wetland Rating

The following system of evaluating wetlands as to their effectiveness in controlling floodwaters categorizes the wetland as: low, medium or high. No attempt should be made to compare wetlands within a category on the sole basis of the numerical rating.

Procedure for Wetland Evaluations

1. Use one sheet for each wetland.
2. Begin at upper end of drainage and work downstream.
3. The downstream wetland of two wetlands in series should be partially completed before rating the upper wetland.

WETLAND EVALUATION

Wetland Name _____ No. ____

FISH HABITAT 2/

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
1. Principal wetland type 1/	5	4 (with some type 5 present)	Other
2. Size (acres of Type 5) 1/	50+	>25 but <50	<25
3. Location of wetland	Immediately adjacent to a lake which supports warm water fish.	Immediately adjacent to a perennial stream that supports warm water fish.	Adjacent to intermittent stream or cut off from streams.
Presence of fish cover	Abundant	Limited	Scarce
Presence of game fish (number of species present)	2 or more	1	None

Total number of items circled in (a) _____ (b) _____

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = _____

RATING: Total is: 8 to 10 = High
5 to 7 = Moderate
0 to 4 = Low

RATING IS: _____

1/ Wetland type pertains to those described in Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, United States Government Printing Office, Washington, D.C., 1971.

2/ There must be some type 5 present to evaluate the wetland for this use. If not rated insert NR in rating blank.

This table is to be completed on drainages with more than one wetland. Wetland areas should be listed working downstream.

Wetland or Other Control	Drainage (ac.)	Storage (ac./ft.)	Upstream Storage (in.) (ac./ft.)	Downstream Storage (in.) (ac./ft.)

WETLAND EVALUATION

Wetland Name _____ No. _____

WETLAND WILDLIFE HABITAT

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
1. Principal wetland type 1/	3 or 4	5, 6 or 7	1, 2 or 8
2. Number of wetland types 1/	3 or more	2	1
3. Diversity of adjacent land use (other than urban types) 2/	3 or more	2	1
4. Percent of perimeter with 300'+ wide buffer strip 3/	80%+	60%+ but <80%	<60%
5. Size (acres)	200 or more	100+ but <200	<100
6. Islands	Yes	---	No

Total number of items circled in: (a) _____ (b) _____

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = _____

RATING: Total is: 9 to 12 = High
5 to 8 = Moderate
0 to 4 = Low
RATING IS: _____

1/ Wetland type pertains to those described in Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, United States Government Printing Office, Washington, D.C., 1971.

2/ The following types will qualify for the diversity determination:
1 type - forestland (any or all type(s) present will collectively constitute the equivalent of one diversity type)
1 type - unused tillable (TU), pasture (T), orchard (O)
1 type - abandoned field (AF), abandoned orchard (AO)
1 type - sand or gravel removal (SG) (inactive)
1 type - recreation land--any one or more of the following types:
RG - golf course, RD - golf driving range, RSK - ski area,
RFG - fairground, RP - urban park

3/ Buffer strip = area adjacent to wetland perimeter without occupied buildings or other urban uses.

WETLAND EVALUATION

Wetland Name _____ No. _____

RECREATION

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
BOATING: (Pleasure and Fishing - canoe and flat bottom)			
1. Principal Wetland Type used for boating (4 or 5)	5	4	All others
2. Acres available (per continuous wetland 4 & 5)	100+	>50 but <100	<50
3. Physical Access (No. of Access Points)	2+	1	0
4. Boatable Stream Present	(enters and leaves wetland)	(enters or leaves wetland)	none present
FISHING: (shoreline)			
5. Principal Wetland Type used for fishing (4 or 5)	5	4 (with some type 5 present)	other
6. Wetland Size (acres)	50+	>25 but <50	<25
7. Physical Access--shore Percent of shoreline from which fishing is available	20%+	5%+ but <20%	<5%
NATURE STUDY:			
8. Diversity of plants and animals (number of types)	3 or more	2	1
9. Percent of urban development within 300 feet of wetland perimeter.	<5%	5% to <25%	25%+
HUNTING:			
10. Waterfowl hunting - amount of Type 3, 4 and 5	100 acres+	25+ but <100	<25 acres
11. Access for hunting	Unlimited	Permission of landowner required	None available

Total number of items circled in (a) _____ (b) _____

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = _____

RATING: Total is: 16 to 22 = High
9 to 15 = Moderate
0 to 8 = Low
RATING IS: _____

WETLAND EVALUATION

Wetland Name _____ No. ____

UNIQUENESS

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
1. Location - wetland surrounded by:	Intensely urban	Suburban	Rural
2. Wetland supports a threatened, endangered, or uncommon species of plant or animal	A threatened or endangered species	An uncommon species	None
3. Wetland contains a regionally rare plant community 1/	Yes	--	No
4. Wetland attracts a regionally significant number of migrating birds	Yes	--	No
5. Wetland is archaeologically, geologically or historically significant	Yes	--	No
6. Size: (acres)*	500 acres and more	200 acres or more but <than 500 acres	< 200 acres

Total number of items circled in: (a) _____ (b) _____

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = _____

RATING: a. Any item 2-6 rating high = High
b. Total is: 3 to 6 = Moderate
0 to 3 = Low RATING IS: _____

1/ Occurs less than 5% of the time in inventoried wetlands.

* Uniqueness due to size may need evaluation by region in Massachusetts. The north and southeastern sections of the state have wetland areas qualifying (under for the above categorization; Western and Central Massachusetts should be re-evaluated in terms of overall wetland size.

WETLAND EVALUATION

Wetland Name _____ No. _____

VISUAL QUALITY

Circle the correct rating for each line entry.

	(a) High	(b) Moderate	(c) Low
1. One or more public roads enables travelers to overlook the wetland at	3+ different locations or 1 mile or more	2 different locations or 1/4 mile+ but <1 mile	1 location or <1/4 mile
2. Overlooks accessible by-path or trail	2 or more overlooks accessible	1 overlook accessible	No overlooks accessible
3. Wetland contains some type 7 wetland consisting of deciduous woodland	75+ acres of red maple	40+ but <75 of red maple	<40 acres
4. Surrounding topography provides potential for developing overlooks	Potential for 2 or more different overlooks	Potential for 1 overlook	No potential for an overlook
5. Wetland contains an island	Yes	---	No
6. Appearance and condition	Undisturbed an natural	Somewhat disturbed and littered	Messy, littered filling, junky
7. Wetland types	Wetland contains some visible Type 4 or 5	Wetland contains some Type 2 or 3	Wetland contains no visible Types 2, 3, 4 or 5

Total number of items circled in (a) _____ (b) _____

Calculation:
No. circled in column (a) x 2 + no. circled in column (b) x 1 = _____

RATING: Total is: 10 to 14 = High
5 to 9 = Moderate
0 to 4 = Low RATING IS: _____

Rationale - Forest Management

CRITERION 1 - PUBLIC OWNERSHIP

Publicly owned forestland is more prone to multiple use management which includes wood fiber production as one of the uses.

CRITERION 2 - STAND SIZE CLASS DISTRIBUTION

The optimum size class distribution is 50 percent sawtimber, 25 percent poletimber and 35 percent seedling-sapling. Sawtimber trees are live trees of commercial species that have the following minimum diameters at breast height--softwoods 9.0 inches and hardwoods 11.0 inches. Poletimber trees are live trees of commercial species at least 5.0 inches in diameter at breast height but smaller than sawtimber size. Seedling-sapling trees are live trees of commercial species with diameters at breast height of less than 5.0 inches.

CRITERION 3 - STAND DENSITY

Optimum wood fiber production is achieved when the stand is fully stocked. One measure of stocking is the amount of crown closure. The greater portion of the forest that is at or near full stocking, the higher the potential for wood fiber production.

CRITERION 4 - PORTION OF WETLAND FORESTED

The greater the amount of the wetland forested, the greater the potential for wood fiber production, and the greater the incentive for the landowner to manage the land for forest products.

CRITERION 5 - FOREST COVER TYPE

The forest cover type of any area is determined by the principal species present. Cedar, red maple, larch/tamarack or green ash are the cover types that have the highest value for wood fiber production. Management of these types would be the most profitable.

CRITERION 6 - SHAPE OF FORESTED WETLAND

A block of forestland of some regular shape is more conducive to management than a long narrow strip of forestland, as might be found along a waterway.

CRITERION 7 - TYPE OF SOIL

The volume of wood that can be grown on a site is directly related to the soil. Peat soils generally produce wood fiber at a much slower rate and poorer quality than mineral soils.

CRITERION 8 - ACCESSIBILITY

Forestland that has roads to and through it is more conducive to management because road construction is one of the major expenses of forest management.

Rationale - Flood Control

To evaluate wetlands for their value in flood control three basic factors are considered, these are: (1) the actual storage, (2) the effectiveness of that storage, (3) the existing need for control downstream (damage potential).

1. The effective storage of a wetland in relation to its drainage area is the single most important factor in flood control. As the inches of runoff storage increases, the more significantly are flows extended over a longer period of time, thus reducing the peak flows from any given storm.
2. Effective upstream storage by reservoirs and other wetlands may already be controlling the flows to the extent that the storage in question may have little effect, even though it has a very effective storage volume.
3. Main stem storage upstream of a potential damage area can have the same effect on peak flows as another wetland. Also, small streams entering a large stream generally have a significantly reduced effect on flows below that point.
4. The effect of a wetland decreases as you move downstream from it. This is because of two things, first, the routing effect of the stream channel and flood plain itself and secondly, as you move downstream the drainage area becomes progressively larger and the considered wetland has less effect.
5. The value or importance of a wetland for flood control is reduced if there is little or no potential for damage downstream regardless of how effective it may be.

Rationale - Fish Habitat

Principal Wetland Type - Type 5 is the only freshwater wetland type that can support fish in all seasons. Type 4 is suitable in spring and fall, but some Type 5 must be present to maintain fish during summer and winter.

Size - The larger the wetland the more fish it will physically support. One hundred acres was considered necessary to rate high in a regionwide inventory.

Location of Wetland - Wetlands are often used for spawning habitat by warm water species of fish. Some species of fish (e.g., golden shiner, chain pickerel) require aquatic vegetation for spawning sites. Warm water lake fishery is dependent on wetland acreage for spawning sites, nutrient inflow, and as young fish rearing areas. Perennial streams supporting warm-water fish benefit from wetlands, but generally less so than lakes. Intermittent streams do not support substantial fishery.

Presence of Fish Cover - Warm-water fish require logs, stumps, pond lilies, watershield, etc. for protective cover. If the wetland surface is covered with 35 percent or more with stumps, lilies and other plants, it will have a rating of abundant; 10 percent or more, but less than 35 percent will rate as moderate; less than 10 percent as scarce.

Presence of Game Fish - If the wetland is included in "An Inventory of the Ponds, Lakes and Reservoirs of Massachusetts" by James A. McCann (published by Water Resources Research Center, University of Massachusetts) and has a specified productivity of 60 or more pounds of fish per acre, the rating will be high. If listed productivity is 40 or more, but less than 60, the rating will be moderate. If listed productivity is less than 40 pounds per acre, the rating will be low.

If the wetland is not included in "An Inventory of the Ponds, Lakes, and Reservoirs of Massachusetts," then the rating will be based on the following:

High rating - 2 or more species of game fish are present
Moderate rating - 1 species of game fish is present
Low rating - no species of game fish is present.

Game fish shall be limited to brook trout, brown trout, largemouth bass, chain pickerel, and northern pike.

Rationale - Wetland Wildlife Habitat

These criteria were developed to rate wetlands for wetland wildlife habitat. Species in this category include shorebirds, waterfowl, herons, bittern, beaver, muskrat, otter, and associated songbirds (e.g., yellow warbler, tree swallow, red-winged blackbird, marsh wren, kingfisher, etc.).

Principal Wetland Type - For wetland wildlife Types 3 and 4 1/ were considered the most valuable. In the northeast 3/4 or more of the Type 3 and 4 wetlands are classified of prime importance to waterfowl. These types are also of high value to the other forms of wetland wildlife itemized above. Types 5, 6 and 7, although not providing as great a diversity of plant life, are of moderate value to wetland wildlife.

Types 1, 2 and 8 are either only infrequently wet or support a very limited diversity of plants (bogs).

Although all wetland types provide habitat for certain species of wildlife, the criteria emphasizes those types with permanent water for the wetland wildlife rating.

1/ Wetlands of the United States, Circular 39, U.S. Department of the Interior, 1971.

Number of Wetland Types - The greater the number of types in a single wetland the greater will be the diversity of flora and fauna in that wetland. Diversity is a common parameter for measuring quality.

Diversity of Adjacent Land Use - Adjacent land uses provide additional feeding or nesting sites for many of the wetland wildlife species.

Buffer Strip - A 300 foot wide or greater buffer strip without occupied buildings or other intensive uses will serve to protect the amenities of the wetland. Buffer strips provide nesting habitat for many species of wetland wildlife. Seventy-five percent of all duck nests are found within 300 feet of water. Nests are seldom found closer than 100 feet of buildings.

Size - A minimum wetland size was necessary to prevent excessive expenditures of time on the wetland inventory portion of the river basin studies. The minimum size varies in different regions of the state depending upon the number and size of wetlands present. It is the intent of the inventory to include only the more significant wetlands in each region, however, smaller wetlands of regional significance may be included.

Islands - Islands provide a preferred nesting site of the mallard, teal and black duck. Islands offer natural protection from predators reluctant to travel over water to reach the island.

Islands also usually provide a diverse vegetative condition especially when the island elevation exceeds 3 feet above the normal water elevation of the wetland.

Rationale - Recreation

These criteria were developed to rate the value of a wetland for canoe or flat bottom boating, fishing, nature study and hunting. These were considered to be the primary recreation activities conducted on wetlands.

Boating

Principal Wetland Type - Type 5 (inland open Freshwater) consists of open water up to 10 feet deep and because it is deep was rated the best suited for boating use.

Type 4 was rated as moderate value for boating because its depth ranges from only 6 inches to 3 feet and it supports a substantial amount of emergent and floating aquatic plant growth.

All other wetland types were considered unsuitable for boating because of: lack of standing water or dense vegetation.

Acres Available - The more boatable water available, the more desirable the boating activity. Continuous wetland means that the wetland inventoried is either one single wetland or is two or more boatable wetlands linked by a boatable stream.

Physical Access - Physical access means that it is convenient to launch a canoe or flat bottom boat without excessive carrying distances or without having to push the craft out through dense woody vegetation to reach open water.

Boatable Stream Present - Access is facilitated and it is more desirable if a boatable stream enters, crosses and leaves a wetland area.

Fishing

Principal Wetland Type - Type 5 is the only wetland type of sufficient depth to support fish during all seasons. Type 4 will support fish in spring and fall but there is likely to be oxygen deficiencies in summer and winter, therefore, the presence of some Type 5 is essential.

Size - The larger the wetland the more attractive it is for fishing and the more fish will be supported. One hundred acres or more in size was considered necessary to rate high in a regionwide inventory.

Physical Access - Shore - Many persons, particularly children desiring to fish do not have boat equipment and their fishing is limited to the shoreline. Some open shoreline free of woody plants and dense herbaceous plants is necessary for casting.

Nature Study

Diversity of Plants and Animals - Each wetland type supports a variety of wetland flora and fauna. The greater the number of wetland types present in the wetland the greater will be the diversity of flora and fauna. The more diversity present the better will be the nature study opportunities.

Wetland Perimeter - Urban development in the 300 foot wide strip would detract from the nature study values of a wetland (noise, pollutants, litter, domestic animals, trail bikes, etc.).

Hunting

Waterfowl Hunting - Types 3, 4 and 5 are the most attractive wetlands for waterfowl and consequently for waterfowl hunting. Although any size wetlands of these types will attract waterfowl, a 100 acre plus wetland was considered to be significant on a regionwide basis.

Access for Hunting - Hunting is only possible where permitted by the landowner or governing agent.

Rationale - Uniqueness

Location of Wetland - There are few situations where wetlands are located in intensely urbanized areas. Where this is the case, the wetland provides many people with the opportunity to observe or study the diverse flora and fauna within the wetland. Close proximimity to schools offers the potential for formal study by school biology and earth science classes.

Threatened, Endangered or Uncommon Species - Science is as yet ignorant of the net results of a species being exterminated and until mankind becomes this sophisticated in his knowledge of the natural environment we had best tread lightly. The diversity of species is an indicator of environmental quality and when the diversity is reduced the environmental quality is likewise reduced. Man is a part of the natural environment and must co-exist with other species in this natural environment.

Migrating Birds - Offers the public an opportunity to see unusual wildlife concentrations.

Archaeologic, Geologic or Historic Significance - This determination will be sought from local, regional and state authorities (e.g. State Historical Society, Regional Planning Authority).

Size - Any wetland greater than 200 acres in size is uncommon in the Commonwealth of Massachusetts.

Rationale - Visual Quality

The visual quality of a wetland is largely dependent upon the wetland's openness and available access from which people can view it. Wetland Types 1/ 2, 3, 4, and 5 are the more open types which people can look at.

Roads around or through a wetland enable people to look out over the wetland even though they don't care to walk into its interior. For those persons wanting to see a wetland, paths or trails facilitate access.

Islands add to the diversity of flora within a wetland and, therefore, contribute to the wetland's visual quality.

Litter detracts from a wetland's appearance and, therefore, absence of litter is a positive factor.

1/ Wetland type pertains to those described in Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, United States Government Printing Office, Washington, D.C., 1971.



APPENDIX C

Public Lakes, Ponds and Reservoirs

Prepared by the Massachusetts Division of Water Resources

The purpose of this phase of the study is to compile a comprehensive listing of public ponds, lakes and reservoirs relative to size, access, flowage rights and ownership, as well as water and shoreline use. The Massachusetts Water Resources Study principals have come to realize that the ownership of our water resources is a question of paramount importance to the public.

Current information on water body status as a public or private resource is often incomplete, inaccurate or out-of-date. Within the framework of this study, the Massachusetts Division of Water Resources found the appropriate opportunity to gather some new information. It is planned that this survey will be continued eventually to cover the entire state and made part of a permanent record system.

At the study's outset, available existing information was used heavily to produce a rough, preliminary working list. Sources used included Department of Public Works (DPW) and Department of Environmental Quality Engineering (DEQE) records, the University of Massachusetts County Lakes, Ponds and Reservoirs Inventories by McCann, et al., in addition to earlier studies conducted by the Division of Fisheries and Wildlife. These sources produced an extensive working list refined according to certain criteria to establish eligibility for the final listings.

A primary objective of this survey is to identify water bodies which should be available for public use. It was found that certain waters could be eliminated quickly. Except for municipally-owned reservoirs over twenty acres in size and water bodies within state or federally owned land, natural ponds under ten acres and wholly man-made private reservoirs were excluded. As a result of applying these criteria, only ponds, lakes and reservoirs of apparent public status and significance remain on this final listing for the Coastal Region.

It should be noted that the designation of "apparent public or great pond status" does not preclude the occurrence of private ownership of some of the water bodies so labeled. However, this classification should signal the need for a full survey pursuant to Chapter 91 or 131 of the General Laws to clear up any remaining question of status on water bodies within this category. When a pond's public status has been ascertained, access can be provided by the Massachusetts Public Access Board acting pursuant to the authority contained in Section 17 of Chapter 21 of the Massachusetts General Laws.

Basic Facts Regarding Great Ponds as Provided by the Colony Ordinance of 1641-7 and its Interpretations

Size
Great Ponds are those over ten acres, except regarding fishing where rights exist in ponds over twenty acres.

Ownership
Pond bottom is owned by the state below the ordinary low water mark.

Rights
Use by the public, so long as one does not trespass on a man's "corn or meadow." A right also exists to seek the provision of a public access to avoid such trespass.

Uses
Fishing, fowling, boating, bathing, skating or riding upon the ice, taking of water for domestic or agricultural purposes, or for use in the arts and the cutting and taking of ice.

Enlarged Great Ponds
Public rights exist in the entire waters of an enlarged natural great pond. In discussing this, Massachusetts Water Laws (1970) states:

> "A reflection upon all of the cases which have been reviewed seems to establish conclusively that all public rights in natural great ponds...can be lawfully exercised in any part of the waters which are impounded by dams erected at the outlet of great ponds containing more than ten acres, except the public right of fishing, which right will be restricted to natural great ponds exceeding twenty acres in size."

By checking records of the county engineer and by comparing the heights of dams with depth data, many enlarged great ponds can be identified. Even with such research and onsite inspections, some water bodies could not definitely be assumed to be great ponds. Formal surveys by the Waterways Division could ascertain their status.

It should be noted that this list is not, therefore, official. It represents our best judgment, bearing in mind that exact measurements are required in borderline cases. The problem of great pond identification is most difficult where an original natural pond has been enlarged by the construction of a dam at its outlet.

The significance of the study is manyfold. It indicates those ponds where the right of public access exists and can be developed under existing law.[1/] It also suggests that other lakes not listed are currently private. Where important private water bodies exist, public funds might be expended to obtain usage rights where appropriate.

1/ Caveat--No right exists to walk along privately-owned shorelines once access is obtained. Public access rights may also be denied by the local water authority where a pond is withdrawn for water supply. Uses may be regulated by towns and state agencies, as authorized by statute.

PARKER STUDY AREA COMMUNITIES

1. Georgetown

Pentucket Pond #5-5-105-1* (PA-3)+ 84 Acres

An enlarged great pond identified by the Division of Waterways (DEQE). No formal public access has been provided. Informal access has been obtained from Pond Street by the Division of Fisheries and Wildlife, which presently maintains a fish stocking program. Flowage is with the Town of Georgetown.

Rock Pond (PA-3) 57 Acres

A natural great pond that has been surveyed by the Division of Waterways (DEQE). Formal public access has been obtained and developed by the Massachusetts Public Access Board.

2. Groveland

Crane Pond (PA-3) 20 Acres

An apparent natural great pond. Informal public access is available across The Crane Pond Area of the Massachusetts Division of Fisheries and Wildlife.

Johnsons Pond #5-5-116-7 (ME-20) 208 Acres

An enlarged great pond, part of the water supply for the City of Haverhill. It has been surveyed by the Division of Waterways (DEQE).

3. Newbury

No lakes, ponds, or reservoirs which meet criteria.

4. Newburyport

No lakes, ponds, or reservoirs which meet criteria.

5. Rowley

No lakes, ponds, or reservoirs which meet criteria.

* Massachusetts Division of Waterways Dam Inspection File Identification Number.

\+ Soil Conservation Service, USDA subwatershed designation.

(CH) Charles Drainage (IP) Ipswich Drainage
(ME) Merrimack Drainage (NE) Neponset Drainage
(NS) North Shore Drainage (PA) Parker Drainage

IPSWICH STUDY AREA COMMUNITIES

1. Boxford

Baldpate Pond (PA-3) 66 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). Informal access from state land in The Georgetown State Forest.

Chadwick Pond (ME-20) 161 Acres

An apparent great pond that has been withdrawn for water supply purposes by the City of Haverhill.

Crooked Pond (IP-4) 6 Acres

A small natural pond which constitutes public waters contained in the Boxford Wildlife Santuary. Access can be gained across the Sanctuary. Fishing is allowed.

Four Mile Pond (IP-4) 54 Acres

A natural great pond. No formal public access has been provided. The pond has been identified by the Division of Waterways (DEQE).

Hoveys Pond (ME-20) 38 Acres

A natural great pond that has been withdrawn for water supply for the City of Haverhill. It is presently closed to public use. It has been surveyed by the Division of Waterways (DEQE).

Spoffords Pond (IP-4) 27 Acres

A natural great pond that has been identified by the Division of Waterways (DEQE). No formal public access has been provided.

Stevens Pond (IP-4) 12 Acres

A natural great pond identified by the Division of Waterways (DEQE). No formal public access has been provided.

Stiles Pond #5-5-38-3, (IP-4) 60 Acres

An apparent enlarged great pond. No formal public access has been provided. Flowage rights are with Chester K. Twist of Boxford.

2. Hamilton

Beck Pond (NS-5) 36 Acres

A natural great pond identified by the Division of Waterways (DEQE). No formal public access has been provided.

Chebacco Lake (NS-5) 209 Acres

A natural great pond. Access has been developed by the Public Access Board. The lake has been surveyed by the Division of Waterways (DEQE).

Gravelly Pond (NS-5) 45 Acres

A natural great pond that has been withdrawn by the Town of Manchester for water supply. It is closed to public recreational use.

Pleasant Lake (IP-4) 43 Acres

A natural great pond that has been surveyed by the Division of Waterways (DEQE). There is no formal public access.

Round Pond (NS-5) 38 Acres

A natural great pond, surveyed by the Division of Waterways (DEQE) that has been withdrawn by the Town of Manchester for water supply. The pond is presently closed to any public recreational use.

3. Ipswich

Clark Pond (PA-3) 27 Acres

An apparent natural freshwater great pond. No formal public access has been provided.

Hood Pond (IP-4) 67 Acres

An apparent natural great pond. Informal access is available through the Willowdale State Forest. The pond is used for recreation.

Willowdale Bog Pond (IP-4) 4 Acres

A shallow public pond, excavated in the extraction of bog iron, on state land in the Willowdale Forest. Informal access is available across the forest.

4. Middleton

Middleton Pond #5-5-184-6, (IP-4) 135 Acres

An apparent enlarged great pond. Access is controlled by the local water authority since it is withdrawn for water supply for Middleton and the City of Danvers. The reservoir is not currently used for recreation, and flowage is with the City of Danvers.

5. North Andover

Berry Pond (IP-4) 4 Acres

A small natural pond. Informal public access is across state land in the Harold Parker State Forest. These public waters are used for recreation.

Lake Cochichewick #5-5-210-6, (ME-20) 592 Acres

An apparent enlarged great pond used as water supply by the Town of North Andover. No public access has been provided. Flowage rights are with the Town of North Andover. The pond is presently closed to public recreational use.

Salem Pond (IP-4) 18 Acres

Artificially created public waters. Access for recreation is through the Harold Parker State Forest which encompasses the pond.

Stearns Pond (IP-4) 46 Acres

An artificial pond on state land in the Harold Parker State Forest. Informal access is available across the forest to these public waters which are used for recreation, presently including swimming.

Sudden Pond (IP-4) 6 Acres

A small natural pond. Access to the public waters is through the Harold Parker State Forest of which this pond is a part. The pond is used for recreation.

6. North Reading

Bradford Pond (IP-4) 14 Acres

An artificial pond located on state land in the Harold Parker State Forest. Informal access to these public waters can be gained through the State Forest. The pond is used for recreation.

6. North Reading (continued)

Martins Pond (IP-4) 92 Acres

A natural great pond. Access to these public waters has been obtained by the Division of Waterways (DEQE).

Swan Pond (IP-4) 45 Acres

An apparent great pond. The waters have been withdrawn for water supply purposes for the City of Danvers. The pond is not presently used for public recreation.

7. Reading

No lakes, ponds, or reservoirs which meet criteria.

8. Topsfield

No lakes, ponds, or reservoirs which meet criteria.

9. Wenham

Coy's Pond (NS-5) 25 Acres

A natural great pond, identified by the Division of Waterways (DEQE). No public access has been provided.

Longham Reservoir #5-5-30-3, (IP-4) 47 Acres

An artificial municipal water supply reservoir. Flowage rights are with the Salem-Beverly Water Supply Board. The reservoir is currently closed to any public use.

Wenham Lake (IP-4) 220 Acres

An apparent enlarged great pond. Water is withdrawn for water supply for the cities of Beverly and Salem. Flowage is with the Salem-Beverly water supply board. The lake is presently closed to public recreational use.

10. Wilmington

Silver Lake (IP-4) 28 Acres

A natural great pond. Informal access can be obtained from State Highway #38.

Fosters Pond (ME-19) 135 Acres

(See Andover)

1. Beverly

Beaver Pond (IP-4) 16 Acres

An apparent great pond for which no public access has been provided.

Longham Reservoir #5-5-30-3 (IP-4) 47 Acres
(See Wenham)

Norwood Pond #5-5-30-2 (IP-4) 45 Acres

A publicly owned artificial pond. Informal public access can be obtained through state land owned by the Massachusetts Board of Regional Community Colleges. Flowage rights are with this agency.

Wenham Lake (IP-4) 220 Acres

An apparent enlarged great pond. Withdrawn for water supply for the cities of Beverly and Salem. Flowage is with the water authority. The pond is presently closed to recreational use.

2. Chelsea

No lakes, ponds, or reservoirs that meet criteria.

3. Danvers

Putnamville Reservoir (IP-4) 266 Acres

An artificial municipal water supply reservoir. Fishing is presently permitted. Flowage is with the Salem-Beverly Water Board.

4. Essex

Chebacco Lake (NS-5) 209 Acres

A natural great pond identified by the Division of Waterways (DEQE). Formal public access has been acquired by the Division of Waterways (DEQE) and by the Public Access Board to the public waters of this pond.

5. Everett

No lakes, ponds, or reservoirs that meet criteria.

6. Gloucester

Babson Reservoir #5-5-107-17 (NS-5) 27 Acres

An artificial reservoir; part of the water supply for the City of Gloucester. It is presently closed to public use. Flowage is with the Gloucester Water Department.

Dykes Pond #5-5-107-3 (NS-5) 58 Acres

An artificial reservoir; part of the water supply for the City of Gloucester. Flowage is with the Gloucester Water Department. There is no present recreational use.

Fernwood Lake #5-5-107-8 to 10 (NS-5) 25 Acres

An artificial reservoir; part of the Gloucester City Water Supply. Flowage is with the water authority. No recreational use is permitted.

Goose Cove Reservoir #5-5-107-18 to 21 (NS-5) 121.5 Acres

A recently constructed reservoir; part of the Gloucester City Water Supply. Flowage is with the Gloucester Water Department. The reservoir is not presently used for recreation.

Haskell Pond #5-5-107-2 (NS-5) 50 Acres

An artificial water supply reservoir owned by the Gloucester Water Department. The reservoir is presently closed to use by the public. The dam is owned by the City of Gloucester.

Lily Pond #5-5-107-4 (NS-5) 34 Acres

An artificial reservoir; auxiliary water supply for the City of Gloucester. Flowage is with the Gloucester Water Department. There is no present public recreational use.

Niles Pond (NS-5) 35 Acres

A natural great pond identified by the Division of Waterways (DEQE). No formal access has been provided.

Wallace Reservoir #5-5-107-6 (NS-5) 25 Acres

An artificial municipal water supply reservoir presently closed to public use. Flowage is with the City of Gloucester Water Department.

7. Lynn

Birch Pond #5-5-163-6 (NS-7) 80 Acres

An artificial pond; part of the water supply for the City of Lynn. Flowage rights are with the City Water Department. Public fishing is presently allowed.

Breeds Pond #5-5-163-4 & 5 (NS-7) 179 Acres

An artificial reservoir which serves as part of the water supply for the City of Lynn. Flowage rights are with the Lynn Water Department. Public fishing is presently allowed.

Flax Pond (NS-6) 46 Acres

A natural great pond identified by the Division of Waterways (DEQE). No formal public access has been provided.

Floating Bridge Pond (NS-6) 13 Acres

An apparent natural great pond. There is no formal public access.

Sluice Pond #5-5-163-2 (NS-6) 50 Acres

An apparent enlarged great pond stocked by the Massachusetts Division of Fisheries and Wildlife. Flowage rights are with the City of Lynn, Sewage Division. There is no formal public access. A town-owned boat launching ramp is present.

Spring Pond #5-5-229-12 (NS-6) 49 Acres

An apparent enlarged great pond which serves as part of the water supply for the City of Peabody. The dam is owned by the city. The pond is presently closed to recreation.

Walden Pond #5-5-163-1 (NS-7) 223 Acres

An artificial municipal reservoir. Public fishing is presently allowed. Flowage is with the City of Lynn (DPW) and is part of the city's water supply.

8. Lynnfield

Hawkes Pond #5-5-262-1 (NS-7) 73 Acres

An artificial reservoir used as water supply. The water rights are owned by the City of Lynn, Department of Public Works. It is presently closed to public recreational use.

Pilling Pond #5-5-164-1 (NS-7) 94 Acres

An apparent enlarged great pond for which no formal public access has been provided.

8. Lynnfield (continued)

Suntaug Lake (IP-04) 154 Acres

An apparent natural great pond used as water supply by the City of Peabody. At present, boating and fishing are allowed for town residents.

Walden Pond #5-5-163-1 (NS-7) 223 Acres

(See Walden Pond - Lynn)

9. Malden

Fellsmere Pond (NS-8) 5.5 Acres

An artificial publicly-owned pond. Informal public access is available since the pond is contained in state land in the Middlesex Fells Reservation, administered by the MDC. The pond is used for recreation.

10. Manchester

No lakes, ponds, or reservoirs that meet criteria.

11. Marblehead

No lakes, ponds, or reservoirs that meet criteria.

12. Melrose

Ell Pond (NS-8) 21 Acres

An apparent natural great pond. No formal public access has been provided. The pond is not presently open to public recreational use.

13. Medford

Middle Reservoir (NS-8) 58 Acres

An artficial municipal reservoir used as water supply by the Town of Winchester. The dam is owned by the town. Fishing is not presently permitted.

South Reservoir (NS-8) 81 Acres

An artificial reservoir which serves as part of the water supply system for the Town of Winchester. Flowage rights are with the town. Fishing is not permitted at present.

13. Medford (continued)

Spot Pond (NS-8) 290 Acres

An apparent enlarged great pond, part of the MDC water supply system. The dam and water rights are owned by the Commission. The pond is presently closed to recreational use.

Lower Mystic Lake (NS-8) 84 Acres

An apparent natural great pond contained in the Middlesex Fells Reservation, administered by MDC. Informal access is available to the public over land in this reservation. The pond is used for recreation.

Upper Mystic Lake #4-9-10-1 (NS-8) 165 Acres

An apparent enlarged great pond. Informal access is available to the public, since the lake is contained in the MDC's Middlesex Fells Reservation. A swimming beach has been developed by the MDC.

Wright's Pond (NS-8) 24 Acres

An artificial municipal pond contained in the City of Medford's Wright Park. Flowage rights are with the city. The pond presently provides recreation for town residents by permit.

14. Nahant

No lakes, ponds, or reservoirs that meet criteria.

15. Peabody

Brown's Pond #5-5-229-11 (NS-6) 26 Acres

An enlarged great pond, identified by the Division of Waterways (DEQE). Flowage rights are with the City of Peabody, Water Department. Swimming and fishing are presently available across town-owned land. There is no formal public access.

Cedar Pond (NS-6) 11 Acres

An apparent natural great pond which serves as emergency water supply for the City of Peabody.

Devils Dishfull Pond #5-5-229-3 (IP-04) 27 Acres

A small artificial municipal pond. The dam is owned by the Peabody Conservation Commission. The pond provides recreation for town residents.

15. Peabody (continued)

Spring Pond #5-5-229-12 (NS-6) 49 Acres

(See Spring Pond, Lynn)

Suntaug Lake (IP-4) 154 Acres

(See Suntaug Lake, Lynnfield)

Winona Pond #5-5-229-14 (IP-04) 92 Acres

An apparent enlarged natural great pond which serves as part of the water supply for the City of Peabody. Flowage is with the City of Peabody Water Department. There is presently fishing by permit for town residents.

16. Revere

No lakes, ponds, or reservoirs that meet criteria.

17. Rockport

Cape Pond (NS-5) 38 Acres

An apparent natural great pond which serves as part of the water supply for the Town of Rockport. It is not presently open to public use.

18. Salem

No lakes, ponds, or reservoirs that meet criteria.

19. Saugus

Birch Pond #5-5-163-6 (NS-7) 80 Acres

(See Birch Pond, Lynn)

Hawkes Pond #5-5-262-1 (NS-7) 73 Acres

(See Hawkes Pond, Lynnfield)

Lower Breakheart Pond #5-5-262-10 (NS-7) 19 Acres

An artificial publicly-owned pond used for recreation. Informal public access to these public waters is available across the Breakheart Reservation, administered by the MDC. A swimming area has been developed. The pond is also known as Pearce Lake.

19. Saugus (continued)

Upper Breakheart Pond (Long John Silver Lake) #5-5-262-9 (NS-7) 13 Acres

An artificial pond is contained in the Breakheart Reservation of the MDC. There is informal public access to the public waters. The pond is used for recreation.

Walden Pond #5-5-262-3 (NS-7) 223 Acres

(See Walden Pond, Lynn)

20. Salem

No lakes, ponds, or reservoirs that meet criteria.

21. Stoneham

Boogum Rock Pond (NS-8) 6 Acres

A small natural pond in the Middlesex Fells Reservation of the MDC. Informal public access is available to the public waters. The pond is used for recreation.

Crystal Lake (NS-8) 80 Acres

An apparent natural great pond. No formal public access has been provided.

Dark Hollow Pond (NS-8) 6 Acres

A small natural public pond which is presently stocked for fishing. Informal access is available for the public, since the pond is contained in the Middlesex Fells Reservation, administered by the MDC.

Doleful Pond (NS-8) 7 Acres

A small natural pond contained in the Middlesex Fells Reservation of the MDC. Informal public access is available through the Reservation. The pond is used for recreation.

Fells Reservoir (NS-8) 8.5 Acres

A small artificial reservoir in the MDC's Middlesex Fells Reservation used as water supply. The dam is owned by the MDC,. and the pond is closed to recreational use.

Middle Reservoir (NS-8) 58 Acres

(See Middle Reservoir, Medford)

21. Stoneham (continued)

North Reservoir (NS-8) 59 Acres

An artificial municipal reservoir used as water supply by the Town of Winchester. Flowage is with the Town of Winchester. Fishing is not presently permitted.

South Reservoir (NS-8) 81 Acres

(See South Reservoir, Medford)

Spot Pond (NS-8) 290 Acres

(See Spot Pond, Medford)

22. Swampscott

No lakes, ponds, or reservoirs that meet criteria.

23. Wakefield

Crystal Lake (NS-8) 80 Acres

(See Stoneham)

Lake Quannipowitt #4-9-305-1 (NS-8) 254 Acres

An enlarged natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided. At present, the town provides public access across town park land to a boat ramp. Flowage rights are owned by the Town of Wakefield.

24. Winchester

Upper Mystic Lake (NS-8) 165 Acres

(See Medford)

Wedge Pond #4-9-344-2 (NS-8) 22 Acres

An enlarged great pond. Formal access for the public has not been provided. Flowage is with the Town of Winchester. The pond has been surveyed by the Division of Waterways (DEQE).

Winter Pond (NS-8) 17 Acres

An apparent natural great pond for which no formal public access has been provided.

24. Winchester (continued)

North Reservoir #4-9-344-1 (NS-8) 55 Acres

(See North Reservoir, Stoneham)

25. Winthrop

No lakes, ponds, or reservoirs that meet criteria.

26. Woburn

Horn Pond (NS-8) 104 Acres

An enlarged apparent great pond. Public access has been provided by the Massachusetts Public Access Board. Flowage is with the City of Woburn.

NEPONSET STUDY AREA COMMUNITIES

1. Boston

Chestnut Hill Reservoir (CH-15) 85 Acres

An artificial reservoir which is part of the MDC's water supply system. Water rights are with the MDC. Although the waters of the reservoir are closed to recreation, the adjacent lands are used extensively.

Jamaica Pond (CH-15) 62 Acres

A natural great pond, surveyed by the Division of Waterways (DEQE). Stocked for fishing by the Division of Fisheries and Wildlife. Fishing is by permit from The Boston Parks and Recreation Department, which administers the adjoining Frederick Law Olmsted Park. Informal access can be gained across this parkland. A boat livery is available.

Sprague Pond (NE-22) 13 Acres

A natural great pond. No formal access has been provided.

2. Canton

Bolivar Pond #6-11-50-4 (NE-19) 29 Acres

An artificial municipally-owned pond. There is no formal public access, and the pond provides fishing for local residents.

2. Canton (continued)

Glen Echo Pond (NE-19) 16 Acres

A natural great pond, identified by the Division of Waterways (DEQE). No formal public access has been provided.

Ponkapoag Pond (NE-20) 209 Acres

An apparent great pond. Informal public access is available through the MDC's Blue Hills Reservation. The pond is used for recreation.

3. Milton

Hillside Pond (NE-21) 3 Acres

An enlarged natural pond in the Blue Hills Reservation of the MDC. Access can be gained across MDC land.

Pine Tree Brook Reservoir #8-11-189-5 (NE-21) 94 Acres

An artificial reservoir was constructed under the Watershed Protection and Flood Prevention Act, (PL-566). The project was a cooperative effort of federal, state and local interests. The reservoir provides flood control and recreational benefits. Informal public access has been provided, and flowage rights are with the Town of Milton.

Hoosiciwhisick Pond (Houghtons Pond) (SS-24) 25 Acres

An apparent natural great pond. Informal access to the waters can be gained across MDC's Blue Hills Reservation. The pond is used for recreation. It is presently stocked with fish by the Division of Fisheries and Wildlife. A beach has been developed.

4. Norwood

Ellis Pond (NE-20) 22 Acres

An artificial municipal pond. The pond provides some recreation for local residents.

5. Sharon

East Pond (TA-55) 2 Acres

An artificial public pond. Informal access can be gained across state land in the Borderland State Park, administered by the DEM. Water rights are with the Commonwealth. The pond is used for recreation. Fishing is presently permitted from nonpower boats.

5. Sharon (continued)

Massapoag Lake #6-11-266-1 (NE-19) 353 Acres

An enlarged natural great pond identified by the Division of Waterways (DEQE). Flowage rights are with the Town of Sharon. Informal access is available for the public to a town-owned swimming beach. The lake is used for recreation.

Middle Pond (TA-54) 6 Acres

A small artificial pond within the Borderland State Park. Informal public access is available across the parkland administered by DEM. Flowage is with the state. The pond is used for recreation.

Pud's Pond (TA-54) 20 Acres

An artificial pond within DEM's Borderland State Park. Flowage rights to the public waters are with the state. Access can be gained through the Park. The pond is used for recreation.

Upper Leach Pond (TA-54) 25 Acres

An artificial public pond within DEM's Borderland State Park. Informal access to these public waters can be gained across this state-owned land. Water rights are with the state. The pond is used for recreation. Fishing is presently permitted from nonpower boats.

West Pond (TA-54) 5 Acres

A small public pond enclosed in Borderland State Park. The water rights are with the state. Informal access is available for the public across this state land. The pond is used for recreation.

Wolomolopoag Pond (TA-55) 11 Acres

A natural great pond identified by the Division of Waterways (DEQE). There is no formal public access.

6. Walpole

Cobbs Pond #6-11-307-15 (NE-17) 26 Acres

An artificial municipally-owned pond that furnishes local recreation. The dam is owned by the Town of Walpole.

7. Westwood

Buckmaster Pond (NE-20) 29 Acres

An enlarged great pond identified by the Division of Waterways (DEQE). Withdrawn for water supply by the Town of Norwood. At present, access for fishing from nonpower boats has been granted to Norwood and Westwood residents by the water authority.

Lyman Pond (NE-20) 26 Acres

An artificial municipally-owned pond. Water rights are with the Town of Westwood. The pond is used for recreation. There is no formal public access.

SOUTHEAST SUBAREA

TAUNTON STUDY AREA COMMUNITIES

1. Abington

Cleveland Pond #7-12-1-2* (TA-48)+ 100 Acres

A publicly-owned artificial pond located in Ames Nowell State Park with informal public access available across the state land. The dam and flowage rights are controlled by the DEM, the agency that administers the Park. The pond is used for recreation.

Island Grove Pond #7-12-1-1 (TA-49) 35 Acres

A municipally-owned artificial pond. Access is limited to town residents. The Town of Abington owns the dam and flowage rights.

2. Avon

Brockton Reservoir #6-11-18-1 (TA-48) 85 Acres

An artificial pond located in the City of Brockton's D. W. Field Park, used as water supply by the City of Brockton. The city also owns the dam and flowage rights. At present, passive recreation is available.

Waldo Lake #7-12-44-9 (TA-48) 75 Acres

A municipally-owned artificial pond located within D. W. Field Park with informal access for recreation provided. The dam and flowage rights are controlled by the City of Brockton.

3. Berkley

No lakes, ponds, or reservoirs which meet criteria.

4. Bridgewater

Carver Pond #7-12-42-7 (TA-51) 31 Acres

A municipally-owned artificial pond. Access is limited to local residents. The dam and flowage rights are controlled by the Town of Bridgewater. The pond is used for recreation.

Lake Nippenicket (TA-47) 354 Acres

A natural great pond designated by the Division of Waterways (DEQE). Access developed for fishing and swimming by the Public Access Board. Surrounding land in the Hockamock Swamp Management Area is used as a wildlife management area by the Division of Fisheries and Wildlife.

Nunkets Pond (Nuggerty Pond) (TA-47) 16 Acres

An apparent natural great pond. Informal access available across Fish and Wildlife land in the Hockamock Wildlife Management Area.

5. Brockton

Thirty-Acre Pond #7-12-44-6 (TA-48) 24 Acres

A municipally-owned artificial pond located in D. W. Field Park. Informal access for recreation is available across the park land. The City of Brockton controls the dam and flowage rights.

6. Dighton

No lakes, ponds, or reservoirs which meet criteria.

7. East Bridgewater

Robbins Pond #7-12-118-1 (TA-49) 124 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE), with access established by the Public Access Board for recreation. The dam is owned by the Town of Halifax, while the flowage rights are controlled by the United Cape Cod Cranberry Corporation.

8. Easton

Ames Long Pond (Long Pond) #6-3-88-1 (TA-47) 75 Acres

A municipally-owned artifical pond used for recreation. A town beach has been developed by the Town of Stoughton. The dam and flowage rights are controlled by the Town of Easton. There is no public access.

8. Easton (continued)

Leach Pond (Wilber Pond) (TA-54) 110 Acres

A publicly-owned artificial pond within Borderland State Park. Fishing from nonpower boats is permitted at present. Informal access for other types of recreation is available across state park land. The DEM controls the dam and flowage rights.

9. Foxborough

Carpenter Pond (Lakeview Pond) #6-11-99-7 (TA-55) 30 Acres

A municipally-owned artificial pond. The dam and flowage rights are with the Foxborough Conservation Commission. No formal public access has been provided.

Upper Dam Pond #6-11-99-8 (TA-55) 21 Acres

A municipally-owned artificial pond. The dam and flowage rights are controlled by the Foxborough Conservation Commission. No formal public access has been provided.

Witch Pond (NB-60) 10 Acres

An apparent natural great pond. There is no formal public access.

10. Freetown

Long Pond (TA-53) 1,721 Acres

(See Long Pond, Lakeville)

11. Halifax

Monponsett Pond (TA-49) 528 Acres

A natural great pond identified by the Division of Waterways (DEQE). The Wamsutta Beach site has been purchased as formal, public access by the Public Access Board. At the present time, swimming is the only developed recreation.

Muddy Pond (TA-49) 15 Acres

An apparent natural great pond for which no public access has been provided.

12. Hanson

Indian Head Pond (SS-27) 121 Acres.

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access.

12. Hanson (continued)

Maquan Pond (SS-27) 45 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access.

Wampatuck Pond #7-12-123-1 (SS-27) 65 Acres

A municipally-owned artificial pond. Access limited to local residents. The Town of Hanson controls the dam and flowage rights.

13. Lakeville

Assawompset Pond (TA-53) 2,024 Acres

An enlarged great pond withdrawn for water supply by the Cities of Taunton and New Bedford. The dam and flowage rights are owned by the City of Taunton. There is no public access or recreational use at present.

Clear Pond (TA-52) 18 Acres

An apparent natural great pond with no public access.

Elders Pond (TA-53) 145 Acres

An apparent natural great pond used as water supply by the City of Taunton. No public access is available.

Long Pond (TA-53) 1,721 Acres

A natural great pond identified by the Division of Waterways (DEQE). Access for recreation established by the Massachusetts Public Access Board at a site located in Freetown. It is used for water supply by the City of New Bedford.

Loon Pond (TA-53) 23 Acres

A natural great pond identified by the Division of Waterways (DEQE). No formal public access.

Great Quittacas Pond (TA-53) 1,185 Acres

An apparent natural great pond used as water supply by the City of New Bedford. Recreation here is limited to boating and fishing by permit for owners abutting the pond only. There is no public access.

Little Quittacas Pond (TA-53) 297 Acres

An apparent natural great pond used as water supply by the City of New Bedford. Access is limited to boating and fishing by permit for owners abutting the pond.

14. Mansfield

Greenwood Lake (Bungay Lake) #6-3-211-7 (NB-60) 130 Acres

A federally-owned artificial lake. There is no formal public access. The U.S. Department of The Interior owns the dam and flowage rights.

15. Middleborough

Pocksha Pond (TA-53) 230 Acres

An apparent natural great pond with no formal public access provided.

Tispaquin Pond (TA-53) 194 Acres

An apparent natural great pond with formal public access. Acquired by the Public Access Board, but not fully developed at the present time.

Woods Pond #7-12-182-2 (TA-53) 50 Acres

An apparent enlarged great pond with no formal public access. It is used as water storage for cranberry bogs. The dam and flowage rights are controlled by John Howes. A license from the Division of Waterways (DEQE) exists on the pond.

16. Norton

Winneconnet Pond (TA-54) 146 Acres

An apparent natural great pond with no formal public access.

17. Plympton

Indian Pond (SS-29) 66 Acres

(See Indian Pond, Kingston)

18. Raynham

Gushee Pond (TA-52) 30 Acres

An apparent natural great pond with no public access.

Lake Nippenicket (TA-47) 354 Acres

(See Lake Nippenicket, Bridgewater)

19. Stoughton

Ames Long Pond #6-3-88-1 (TA-47) 75 Acres

(See Ames Long Pond, Easton)

Pinewood Pond #6-11-285-2 (NE-19) 21 Acres

A municipally-owned artificial pond used as a secondary water supply. The Town of Stoughton controls the dam and flowage rights. No public access has been provided.

Welch Pond (TA-47) 40 Acres

A municipally-owned artificial pond used for water retention and recreation for local residents. The Stoughton Conservation Commission owns the dam and flowage rights. There is no public access.

Woods Pond (NE-19) 25 Acres

An artificial pond used for water storage with no public recreational use at present. The Town of Stoughton owns the dam and flowage rights.

20. Taunton

Big Bearhole Pond (Deans Factory Pond) #6-3-293-15 (TA-52) 40 Acres

An artificial pond located in the Massasoit State Park. Informal public access for recreation is available across this state land. The DEM controls the dam and flowage rights.

Little Bearhole Pond (TA-52) 5 Acres

An artificial pond located in the Massasoit State Park with public access for recreation. The dam and flowage rights along with the administration of the park are with te DEM.

Black Pond (TA-54) 11 Acres

A great pond surveyed by the Division of Waterways (DEQE). No formal public access.

Middle Pond #6-3-293-16 (TA-52) 20 Acres

An artificial pond located within Massasoit State Park. Informal public access for recreation is available across this state land. The DEM controls the dam and flowage rights and administers the state park.

20. Taunton (continued)

Prospect Hill Pond (TA-52) 42 Acres

An apparent natural great pond with no formal public access.

Sabbattia Lake (Seading Pond) #6-3-293-4 (TA-54) 255 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE). Public access for boating has been developed by the Massachusetts Public Access Board. The dam and flowage rights are controlled by Dye Craftsman, Inc. of Taunton.

Watson Pond (TA-54) 70 Acres

An apparent enlarged great pond contiguous to the Watson Pond State Park. Informal public access for recreation can be obtained across the park. The DEM controls the dam and flowage rights, and administers the state oark.

21. West Bridgewater

Town River Pond #7-12-322-3 (TA-47) 30 Acres

A municipally-owned artificial pond. At present, access is available to town residents for recreation. The Town of West Bridgewater owns the dam and flowage rights.

West Meadow Pond #7-12-322-3 (TA-47) 20 Acres

A publicly-owned artificial pond within the West Meadows Wildlife Management Area. The Division of Fisheries and Wildlife owns the dam and flowage rights. Presently, it is not being used for recreation.

BUZZARDS BAY STUDY AREA COMMUNITIES

1. Acushnet

New Bedford Reservoir #6-3-3-3 (BB-45) 220 Acres

A municipal artificial reservoir used for irrigation and recreation for town residents. The dam and flowage rights are controlled by the Town of Acushnet.

2. Carver

Barrett Pond (BB-41) 14 Acres

An apparent natural great pond for which there is informal access for recreation through Myles Standish State Forest, under the jurisdiction of the DEM.

2. Carver (continued)

Bates Pond (BB-42) 20 Acres

An apparent natural great pond. No formal public access has been provided.

Cedar Pond (BB-43) 12 Acres

An apparent natural great pond for which there is no formal public access.

Clear Pond (BB-43) 11 Acres

An apparent natural great pond. There is no formal public access to the waters.

Coopers Pond (TA-50) 23 Acres

A natural great pond identified by the Division of Waterways (DEQE). No formal access has been provided.

Dunham Pond (BB-43) 45 Acres

A natural great pond identified by the Division of Waterways (DEQE). Formal public access has been provided by the same agency.

Fresh Meadow Pond #7-12-52-9 (BB-42) 60 Acres

An apparent enlarged great pond used as water storage for cranberry bogs. The A. D. Makepeace Company controls the dam and flowage rights.

John's Pond (TA-50) 21 Acres

An apparent natural great pond. There is no formal public access.

Ricketts Pond (TA-50) 11 Acres

An apparent natural great pond. There is no formal public access.

Sampson Pond (BB-43) 310 Acres

A natural great pond designated by the Division of Waterways (DEQE). No formal public access.

Vaughn Pond #7-12-52-52 (BB-42) 22 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE). It is used for the irrigation of cranberry bogs. The dam and flowage rights are owned by Louis Poduck. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from this pond. No public access has been provided.

2. Carver (continued)

Wenham Pond (BB-42) 50 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE) and used for cranberry bog irrigation. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from this pond. No public access has been provided.

3. Dartmouth

Cedar Dell Lake (BB-45) 24 Acres

An apparent natural great pond. No formal public access.

Georges Pond (BB-45) 16 Acres

An apparent natural great pond located within the Demarest Lloyd State Park, under the jurisdiction of the DEM. Informal access for fishing, boating, and swimming is available across state park land.

Noquochoke Lake #6-3-72-1 (BB-46) 165 Acres

An artificial pond used as secondary water supply by the City of Fall River. Access is available for local residents presently.

West Noquochoke Pond (BB-46) 20 Acres

An artificial pond used as a secondary water supply by the City of Fall River. Access is presently available only for town residents.

Salters Point Pond (BB-45) 58 Acres

An apparent natural great pond. There is no formal public access.

4. Fairhaven

Sconticut Neck Pond (BB-45) 13 Acres

An apparent natural great pond with no formal public access.

5. Fall River

Cook Pond (Laurel Lake) #6-3-95-14 (NB-71) 154 Acres

An apparent enlarged great pond with public access for fishing. A boat ramp has been developed by the Massachusetts Division of Fisheries and Wildlife. The dam and flowage rights are with the City of Fall River.

5. Fall River (continued)

Copicut Reservoir #6-3-95-16 (BB-46) 550 Acres

An artificial municipal water supply reservoir for the City of Fall River. Water rights are with the Watuppa Water Board. The reservoir is currently closed to public use.

North Watuppa Lake (North Watuppa Reservoir) #6-3-95-13 (NB-71) 1,750 Acres

An enlarged great pond identified by the Division of Waterways (DEQE) and is used as a municipal water supply by the City of Fall River. Water rights are with the City of Fall River, with access being restricted.

South Watuppa Pond #6-3-95-3, 4 (NB-71) 1,660 Acres

An apparent enlarged great pond used for an industrial water supply. Formal access for boating has been developed by the Massachusetts Public Access Board. The dam and flowage rights are with the City of Fall River.

Sawdy Pond #6-3-334-2 (NB-71) 370 Acres

(See Sawdy Pond, Westport)

6. New Bedford

Sassaquin Pond (TA-53) 34 Acres

A natural great pond designated by the Division of Waterways (DEQE). No formal public access available.

7. Rochester

Long Pond (Black Pond) (BB-44) 33 Acres

An apparent natural great pond with no public access.

Mary's Pond (BB-44) 81 Acres

An apparent natural great pond with no formal public access.

Snipatuit Pond (BB-44) 710 Acres

An enlarged great pond identified by the Division of Waterways (DEQE). Informal public access is available across state land administered by the Massachusetts Division of Fisheries and Wildlife. The dam and flowage rights are also with the state.

7. Rochester (continued)

Snows Pond (BB-44) 58 Acres

An apparent natural great pond with no formal public access.

Rochester Rearing Reservoir (BB-44) 4 Acres

An artificial pond owned by the Massachusetts Division of Fisheries and Wildlife. Informal access for fishing is permitted off Snipatuit Road. The dam and flowage rights are controlled by the Massachusetts Division of Fisheries and Wildlife.

8. Wareham

Blackmore Pond (BB-42) 46 Acres

A great pond surveyed by the Division of Waterways (DEQE). No formal public access.

Cedar Pond (BB-41) 12 Acres

An apparent natural great pond. No formal public access.

Dicks Pond (BB-41) 40 Acres

An apparent enlarged great pond. The waters are used for cranberry bog irrigation by Daniel O'Connor. No public access has been provided.

Little Long Pond (BB-41) 18 Acres

An apparent natural great pond. Public access has not been obtained.

Sand Pond (Jonathan's Pond) (BB-41) 15 Acres

An apparent natural great pond with no public access. It is used for water supply by the Town of Wareham.

Sandy Pond (Pickerel Pond) (BB-41) 18 Acres

An apparent natural great pond which has been withdrawn for water supply by the Town of Wareham. No access for recreational use is presently permitted.

Spectacle Pond (BB-41) 42 Acres

An apparent natural great pond with no formal public access.

Tremont Mill Pond #7-12-310-8 (BB-42) 33 Acres

A municipally-owned artificial pond currently used for cranberry bog irrigation and recreation for town residents. The dam and flowage rights are controlled by the Town of Wareham.

8. Wareham (continued)

Union Pond (BB-41) 25 Acres

An apparent natural great pond with no formal public access.

White Island Pond #7-12-310-18 (BB-41) 294 Acres

An apparent enlarged great pond used for the irrigation of cranberry bogs and recreation for local residents. The A. D. Makepeace Company controls the dam and flowage rights. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from the pond.

9. Westport

Cockeast Pond (BB-46) 99 Acres

An apparent natural great pond with no formal public access.

Devol Pond (NB-71) 108 Acres

An apparent natural great pond which has been withdrawn for water supply by the City of Fall River. The water rights are owned by the city. Access is limited to local residents. Fishing is allowed.

North Watuppa Lake #6-3-95-13 (NB-71) 1,750 Acres

(See North Watuppa Lake, Fall River)

Richmond Pond (BB-46) 67 Acres

An apparent natural great pond with no formal public access.

Sawdy Pond #6-3-334-2 (NB-71) 363 Acres

An apparent enlarged great pond which has been withdrawn for water supply by the City of Fall River. Water rights are with the city. At present, access is available to local residents for recreation.

South Watuppa Lake #6-3-95-3, 4 (NB-71) 1,660 Acres

(See South Watuppa Lake, Fall River)

NARRAGANSETT BAY STUDY AREA

1. Attleboro

Luther Reservoir #6-3-16-9 (NB-60) 25 Acres

A municipally-owned artificial pond used for water supply by the City of Attleboro. The dam and flowage rights are controlled by Attleboro. Fishing is permitted for town residents.

1. Attleboro (continued)

Manchester Reservoir #6-3-16-12 (NB-60) 225 Acres

An artificial municipal water supply reservoir. Water rights are with the City of Attleboro. Fishing is available for town residents.

Orrs Pond (Upper Orrs Reservoir) #6-3-16-5 (NB-60) 50 Acres

An artificial reservoir which serves as part of the water supply for the City of Attleboro. The dam and flowage rights are controlled by Attleboro. For town residents, fishing is allowed.

2. North Attleborough

Coral Lake (Falls Pond North) #6-3-211-12 (NB-60) 60 Acres

A municipally-owned artificial pond with recreational access for boating established by the Public Access Board. The North Attleborough Conservation Commission controls the dam and flowage rights.

Hoppin Hill Reservoir #6-3-211-5 (NB-60) 35 Acres

An artificial reservoir used for water supply by the City of Attleboro. The city owns the dam and flowage rights. Fishing is allowed for town residents only.

Reservoir Pond (NB-60) 45 Acres

An enlarged great pond. Access for recreation is limited to town residents. The North Attleborough Conservation Commission owns the dam and flowage rights. There is no formal public access.

3. Plainville

Lake Mirimichi (Shepards Pond) #6-11-283-7 (TA-55) 170 Acres

An enlarged great pond with no formal public access. The dam and flowage rights are controlled by the City of Attleboro for use as a secondary water supply.

4. Rehoboth

No lakes, ponds, or reservoirs meet criteria.

5. Somerset

Somerset Reservoir #6-3-273-1 (NB-72) 165 Acres

A municipally-owned artificial water supply reservoir. The dam and flowage rights are controlled by the Town of Somerset. The reservoir is currently closed to public recreational use.

6. Swansea

No lakes, ponds, or reservoirs meet criteria.

CAPE COD AND ISLANDS REGION
PUBLIC LAKES, PONDS AND RESERVOIRS

CAPE COD STUDY AREA COMMUNITIES

1. Barnstable

Aunt Betty Pond (CC-38)+ 10 Acres

An apparent natural great pond for which no public access has been provided.

Bearse Pond (CC-39) 65 Acres

An apparent natural great pond with informal access through state land under the jurisdiction of the Department of Fisheries and Wildlife.

Crystal Lake (CC-39) 10 Acres

An apparent natural great pond. No formal public access has been provided.

Eagle Pond (CC-39) 10.5 Acres

An apparent natural great pond with no formal public access provided.

Elizabeth Pond (CC-39) 13 Acres

An apparent natural great pond with no formal public access available.

Garretts Pond (CC-32) 24 Acres

An apparent natural great pond with no formal public access.

Hamblins Pond (CC-39) 149 Acres

A natural great pond identified by the Division of Waterways (DEQE). The pond is presently stocked by the Massachusetts Division of Fisheries and Wildlife. There is no formal public access. A license from the Division of Waterways exists to withdraw water from the pond.

Hathaway Pond North (CC-39) 20 Acres

An apparent natural great pond stocked by the Massachusetts Division of Fisheries and Wildlife. No formal public access has been provided.

1. Barnstable (continued)

Hathaway Pond South (CC-39) 11 Acres

An apparent natural great pond. No formal public access has been provided.

Hinckley Pond (CC-32) 11 Acres

An apparent natural great pond. No formal public access has been provided.

Joshua Pond (CC-39) 14 Acres

An apparent natural great pond with no formal public access.

Lamson Pond (CC-38) 14 Acres

An apparent natural great pond with no formal public access.

Little Pond (CC-39) 11 Acres

An apparent natural great pond. No formal public access has been provided. A license from the Division of Waterways (DEQE) exists to withdraw water from the pond.

Long Pond (CC-39) 50 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) There is no formal public access. The pond is located near Centerville.

Long Pond (CC-39) 50 Acres

A natural great pond designated by the Division of Waterways (DEQE), with no formal public access. It is located in the Newtown section of Barnstable.

Lovells Pond (CC-39) 54 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). Formal public access for recreation has been obtained by the Public Access Board. A boat landing has been constructed. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife.

Mary Dunn's Pond (Half-Way Pond) (CC-38) 16 Acres

An apparent natural great pond that has been withdrawn for water supply by the Town of Barnstable. It is not presently used for recreation.

1. Barnstable (continued)

Micah Pond (CC-39) 14 Acres

An apparent natural great pond with no formal public access.

Middle Pond (Middle Cotuit Pond) #7-1-20-9 (CC-39) 104 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE). No public access has been provided. The dam and flowage rights are owned by A. D. Makepeace Company. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from the pond.

Mill Pond (CC-32) 21 Acres

An apparent natural great pond located in West Barnstable with no formal public access.

Muddy Pond (CC-39) 27 Acres

An apparent natural great pond. No formal public access has been provided.

Mystic Lake (CC-39) 146 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from the pond.

Neck Pond (CC-39) 15 Acres

An apparent natural great pond. There is no formal public access.

Parker Pond (CC-39) 13 Acres

An apparent natural great pond with no public access.

Shallow Pond (CC-39) 67 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access.

Shubael Pond (CC-39) 56 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). Public access for recreation has been acquired by the Public Access Board. A landing for small boats has been constructed. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife.

1. Barnstable (continued)

Wequaquet Lake (Chequaquet) #7-1-20-8 (CC-39) 654 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE). There is no formal public access. The dam and flowage rights are with the Town of Barnstable. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from the pond.

2. Bourne

Bourne Pond (BB-41) 10 Acres

An apparent natural great pond with no formal public access.

Flax Pond (Picture Lake) (CC-40) 27 Acres

An apparent natural great pond with no public access.

Goat Pond (Goat Pasture Pond) (BB-41) 24 Acres

An apparent natural great pond with no formal public access.

Great Herring Pond (SS-31) 410 Acres

(See Plymouth)

Queen Sewell Pond (Bumps Pond) (BB-41) 18 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). There is no public access. A license from the Division of Waterways (DEQE) exists to withdraw water from the pond.

3. Brewster

Black Pond (CC-38) 11 Acres

An apparent natural great pond with no formal public access.

Blueberry Pond (CC-33) 25 Acres

An apparent natural great pond with no formal public access.

Cahoon Pond (Bush Beach Pond) (CC-38) 29 Acres

An apparent natural great pond with no public access provided.

Canoe Pond (Sam Hill Pond) (CC-33) 12 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided.

3. Brewster (continued)

Cliff Pond (CC-33) 193 Acres

A natural great pond identified by the Division of Waterways (DEQE). Informal public access to the public waters can be gained across the Nickerson State Park administered by the DEM. The pond is stocked by the Massachusetts Division of Fisheries and Wildlife. Access for boating has been developed by the Public Access Board.

Little Cliff Pond (CC-33) 33 Acres

A natural great pond identified by the Division of Waterways (DEQE) and located within the Nickerson State Park. Access for boating has been developed by the Massachusetts Public Access Board. The pond is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Cobbs Pond (CC-33) 21 Acres

An apparent natural great pond with no public access.

Elbow Pond (CC-33) 31 Acres

An apparent great pond with no formal public access.

Eel Pond (CC-33) 3 Acres

A publicly-owned natural pond located in Nickerson State Park provides passive recreation. Informal access can be gained across the park land administered by DEM.

Flax Pond (CC-33) 48 Acres

A great pond identified by the Division of Waterways (DEQE). The public waters are within the DEM's Nickerson State Park. Informal access can be obtained across the state land. A swimming area has been developed by the Massachusetts Division of Forests and Parks, and the pond is presently stocked with fish by the Massachusetts Division of Fisheries and Wildlife.

Grassy Nook Pond (CC-33) 8 Acres

A small natural pond located within Nickerson State Park. Informal access for passive recreation can be gained across state land.

Griffith's Pond (Snow's, White's) (CC-33) 30 Acres

A natural great pond designated by the Division of Waterways (DEQE). No formal public access is available.

3. Brewster (continued)

Higgins Pond (CC-33) 25 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) and located within the Nickerson State Park, administered by DEM's Division of Forests and Parks. A boating access ramp has been developed. The pond is presently stocked with fish by the Massachusetts Division of Fisheries and Wildlife.

Greenland Pond (Eldridge) (CC-38) 37 Acres

An apparent natural great pond with no public access.

Keeler Pond (CC-33) 4 Acres

A small natural pond located within Nickerson State Park. There is informal access for passive recreation available through State Park land.

Long Pond (CC-38) 743 Acres

A natural great pond designated by the Division of Waterways (DEQE). There is no formal public access.

Lower Mill Pond #7-1-41-1 (CC-33) 40 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE). No formal public access has been obtained to the public waters. The dam and flowage rights are owned by the Town of Brewster. It is used for recreation by local residents. A license from the Division of Waterways (DEQE) exists to withdraw water from the pond.

Upper Mill Pond (Mill Pond, Middle, Walker) (CC-33) 253 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) with no formal public access.

Pine Pond (CC-33) 20 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided.

Ruth Pond (CC-33) 8 Acres

A publicly-owned natural pond located in Nickerson State Park. A public access ramp constructed by the Civilian Conservation Corps (CCC) makes fishing and boating available.

3. Brewster (continued)

Seymour Pond (Bangs Pond) (CC-38) 168 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided.

Sheep Pond (CC-38) 142 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). Boating access has been provided by the Public Access Board. The pond is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Slough Pond (Walkers Pond) (CC-33) 27 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided.

Smalls Pond (CC-38) 19 Acres

An apparent natural great pond with no public access.

Smith Pond (CC-33) 10 Acres

An apparent natural great pond. No formal public access has been provided.

Walkers Pond (Upper Mill Pond) (CC-33) 105 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). Formal public access has also been provided by the Division of Waterways (DEQE) under Section 18A.

4. Chatham

Emery Pond (CC-37) 13 Acres

An apparent natural great pond. No formal public access has been provided.

Goose Pond (CC-37) 38 Acres

A natural great pond designated by the Division of Waterways (DEQE). There is no formal public access. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Lover's Lake (CC-37) 36 Acres

An apparent natural great pond with no formal public access.

8. Harwich (continued)

Briggs Pond (Joseph's Pond) (CC-38) 19 Acres

An apparent natural great pond for which no public access has been provided.

Bucks Pond (Walker's Pond) (CC-38) 29 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). Formal public access to these public waters has been provided by the Division of Waterways (DEQE).

Cornelius Pond (Briar Pond) (CC-38) 11 Acres

An apparent natural great pond with no formal public access.

Eldridge's Pond (Walker's Pond) (CC-38) 25 Acres

An apparent natural great pond for which no formal public access has been provided.

Flax Pond (CC-38) 15 Acres

An apparent natural great pond with no formal public access.

Grass Pond (CC-38) 46 Acres

An apparent natural great pond with no formal public access.

Grassy Pond (CC-38) 11.5 Acres

An apparent natural great pond with no public access.

Herring River Pond Reservoir (North Harwich Reservoir) #7-1-126-6 (CC-38) 65 Acres

A municipal artificial reservoir with no public access. The dam and flowage rights are owned by the Town of Harwich. The reservoir is used for cranberry bog irrigation.

Hinckley Pond (Pleasant Pond) #7-1-126-4 (CC-38) 171 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE). There is no public access. The dam and flowage rights are owned by the Town of Harwich. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from the pond.

Island Pond (CC-38) 17 Acres

An apparent natural great pond for which no public access has been provided.

8. Harwich (continued)

Oliver Pond (Kenney's, Hawks Nest) (CC-38) 12 Acres

An apparent natural great pond. No formal public access has been provided.

Robbins Pond #7-1-126-3 (CC-38) 28 Acres

An apparent enlarged great pond with no public access. The dam and flowage rights are owned by R. Gallagher.

Sand Pond #7-1-126-2 (CC-38) 21 Acres

An apparent enlarged great pond with no formal public access. The dam and flowage rights are owned by R. L. Thacher.

Skinequit Pond (CC-38) 15 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided to these public waters.

Hawks Nest Pond (Walkers Pond) (CC-38) 30 Acres

An apparent natural great pond for which no public access has been provided.

9. Mashpee

Ashumet Pond (CC-40) 214 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) adjacent to the Crane Wildlife Management Area and Audubon land. It is stocked by the Massachusetts Division of Fisheries and Wildlife. Access has been developed by the Public Access Board.

Jim Pond (CC-40) 11 Acres

An apparent natural great pond with no formal public access.

Johns Pond #7-1-172-4 (CC-40) 317 Acres

An enlarged great pond identified by the Division of Waterways (DEQE). Public access has been developed by the Massachusetts Public Access Board. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife. The dam and flowage rights are owned by A. D. Makepeace Company.

9. Mashpee (continued)

Mashpee and Wakeby Ponds #7-1-172-1 (CC-39) 729 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE) with public recreational access developed by the Public Access Board. It is stocked by the Massachusetts Division of Fisheries and Wildlife. The dam and flowage rights are owned by the Town of Mashpee.

Moody Pond (CC-40) 18 Acres

An apparent natural great pond with no public access provided.

Santuit Pond #7-1-172-6, 7 (CC-39) 166 Acres

An enlarged great pond surveyed by the Division of Waterways (DEQE) with no formal public access. The dams and flowage rights are owned by A. D. Makepeace Company (N.E. side) and the Town of Mashpee (N.W. side). A license from the Division of Waterways (DEQE) exists to withdraw water from the pond.

10. Orleans

Baker Pond (CC-33) 32 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) with informal access available through the Massachusetts Division of Fisheries and Wildlife land. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Cedar Pond (CC-37) 17 Acres

An apparent natural great pond. No formal access has been provided.

Crystal Lake (Fresh Pond) (CC-37) 36 Acres

An apparent natural great pond with no public access. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife. A license from the Division of Waterways (DEQE) exists to withdraw water from the pond.

Pilgrim Lake (Dean Sparrows Pond) (CC-37) 39 Acres

A natural great pond designated by the Division of Waterways (DEQE) with no formal public access.

11. Provincetown

Clapps Pond (Clappers Pond) (CC-36) 44 Acres

An apparent natural great pond with no public access.

11. Provincetown (continued)

Shank Painter Pond (CC-36) 15 Acres

An apparent natural great pond with no public access.

12. Sandwich

Goodspeed Cemetery Pond (CC-39) 11 Acres

An apparent natural great pond with no formal public access.

Hog Pond Upper (CC-39) 11 Acres

An apparent natural great pond with informal access through the Massachusetts Division of Fisheries and Wildlife land.

Lawrence Pond (CC-39) 138 Acres

A natural great pond designated by the Division of Waterways (DEQE) with informal access through the Massachusetts Division of Fisheries and Wildlife land.

Peters Pond (CC-39) 127 Acres

A natural great pond identified by the Division of Waterways (DEQE) with public access for boating developed by the Public Access Board. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Pimlico Pond (CC-39) 14 Acres

An apparent natural great pond with no formal public access. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Shawnee Lake, Lower #7-1-261-1 (CC-32) 24 Acres

A municipally-owned artificial pond with no public access. The dam and flowage rights are owned by the Town of Sandwich.

Snake Pond (CC-40) 83 Acres

A natural great pond designated by the Division of Waterways (DEQE). There is no formal public access to the pond.

Spectacle Pond (CC-39) 91 Acres

A natural great pond surveyed by the Division of Waterways (DEQE), having no formal public access. It is stocked by the Massachusetts Division of Fisheries and Wildlife.

12. Sandwich (continued)

Triangle Pond (CC-39) 77 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). There is no formal public access.

Weeks Pond (CC-40) 15 Acres

An apparent natural great pond with no formal public access.

13. Truro

Great Pond (CC-35) 17 Acres

An apparent natural great pond with no formal public access. It is presently stocked with fish by the Massachusetts Division of Fisheries and Wildlife.

Horseleach Pond (CC-35) 24 Acres

An apparent natural great pond with no public access.

Ryder Pond (Johnson's or Aunt Mary Ryder Pond) (CC-35) 18 Acres

An apparent natural great pond. No public access has been provided.

Slough Pond (CC-35) 28 Acres

An apparent natural great pond with no formal public access.

14. Wellfleet

Duck Pond (CC-35) 13 Acres

An apparent natural great pond with no public access.

Dyer Pond (CC-35) 10 Acres

An apparent natural great pond with no public access.

Great Pond (CC-35) 37 Acres

An apparent natural great pond with no public access.

Gull Pond (CC-35) 103 Acres

An apparent natural great pond with no public access. It is presently stocked for fishing by the Massachusetts Division of Fisheries and Wildlife.

14. Wellfleet (continued)

Herring Pond (CC-35) 19 Acres

An apparent natural great pond having no public access.

Higgins Pond (CC-35) 28 Acres

An apparent natural great pond with no public access.

Long Pond (CC-35) 34 Acres

A natural great pond identified by the Division of Waterways (DEQE) with no formal public access.

Williams Pond (CC-35) 10 Acres

An apparent natural great pond with no formal public access.

15. Yarmouth

Dennis Pond (CC-38) 50 Acres

An apparent natural great pond with no public access.

Flax Pond (CC-38) 10 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided.

Greenough Pond (Taylors Pond) (CC-38) 20 Acres

An apparent natural great pond with no public access.

Horse Pond (CC-38) 28 Acres

An apparent natural great pond with no formal public access.

Long Pond #7-1-351-1 (CC-38) 57 Acres

An enlarged great pond identified by the Division of Waterways (DEQE) with no formal public access. The dam and flowage rights are owned by the Town of Yarmouth. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from the pond.

Mill Pond (CC-38) 60 Acres

An apparent natural great pond with no public access. One or more licenses from the Division of Waterways (DEQE) exist to withdraw water from the pond.

15. Yarmouth (continued)

Plashes Pond #7-1-351-2 (CC-38) 44 Acres

An apparent enlarged great pond with no formal public access. The dam and flowage rights are owned by A. D. Makepeace Company.

Big Sandy Pond (CC-38) 16 Acres

An apparent natural great pond with no public access.

Little Sandy Pond (CC-38) 14 Acres

An apparent natural great pond with no public access.

ISLANDS STUDY AREA COMMUNITIES

MARTHA'S VINEYARD

1. Chilmark

Black Point Pond (IS-69) 80 Acres

An apparent natural great pond with no public access.

Chilmark Pond (IS-69) 278 Acres

A natural great pond identified by the Division of Waterways (DEQE). No public access has been provided.

Harlock Pond (IS-69) 14 Acres

An apparent natural great pond with no formal public access.

Nomans Land East Pond (IS-69) 14 Acres

An apparent natural great pond with no formal public access.

Nomans Land West Pond (IS-69) 12 Acres

An apparent natural great pond with no public access.

Quenames Cove (IS-69) 17 Acres

An apparent natural great pond with no public access.

Squibnocket Pond (IS-69) 554 Acres

A natural great pond designated by the Division of Waterways (DEQE) with no formal public access.

1. Chilmark (continued)

Squibnocket Ridge Pond (IS-69) 13 Acres

An apparent natural great pond with no public access.

2. Edgartown

Edgartown Great Pond (IS-69) 1,157 Acres

A natural great pond designated by the Division of Waterways (DEQE) with no formal public access.

Jobs Neck Pond (IS-69) 68 Acres

An apparent natural great pond with no public access.

Jobs Neck East Pond (IS-69) 17 Acres

An apparent natural great pond with no formal public access.

Oyster Pond (IS-69) 207 Acres

An apparent natural great pond with no public access.

Paqua Pond (IS-69) 14 Acres

An apparent natural great pond with no public access.

Trapps Pond (IS-69) 45 Acres

An apparent natural great pond with no public access.

3. Gosnold

Gosnold Pond (IS-69) 41 Acres

An apparent natural great pond with no public access.

Quicks Hole Pond (IS-69) 82 Acres

An apparent natural great pond with no formal public access.

South Bluff Road Pond (IS-69) 10 Acres

An apparent natural great pond with no public access.

Westend Pond (IS-69) 65 Acres

An apparent natural great pond with no formal public access.

4. Oak Bluffs

Crystal Lake (IS-69) 12 Acres

An apparent natural great pond with no formal public access.

Farm Pond (IS-69) 33 Acres

An apparent natural great pond with no public access.

5. West Tisbury

Black Water Pond (IS-69) 12 Acres

An apparent natural great pond with no formal public access.

Doggetts Pond (IS-69) 10 Acres

An apparent natural great pond with no formal public access.

Homers Pond (IS-69) 43 Acres

An apparent natural great pond with no public access.

James Pond (IS-69) 37 Acres

A natural great pond designated by the Division of Waterways (DEQE). No formal public access has been provided.

Long Cove (IS-69) 83 Acres

An apparent natural great pond with no formal public access.

Old House Pond (IS-69) 11 Acres

An apparent natural great pond with no public access.

Seths Pond (IS-69) 12 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been provided.

Watcha Pond (IS-69) 68 Acres

An apparent natural great pond with no formal public access.

6. Nantucket

Copaun Pond (IS-70) 18 Acres

An apparent natural great pond with no public access.

Coskata Pond (IS-70) 44 Acres

An apparent natural great pond with no formal public access available.

Gibbs Pond (IS-70) 34 Acres

An apparent natural great pond with no formal public access.

Head of Hummock Pond (IS-70) 17 Acres

An apparent natural great pond with no public access.

Hummock Pond (IS-70) 220 Acres

A natural great pond identified by the Division of Waterways (DEQE). No formal public access has been obtained.

Long Pond (IS-70) 70 Acres

An apparent natural great pond with no public access.

Miacomet Pond (IS-70) 34 Acres

An apparent natural great pond with no public access.

North Headlong Pond (IS-70) 55 Acres

An apparent natural great pond with no public access.

Seschacha Pond (IS-70) 276 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access has been obtained.

Tom Nevers Pond (IS-70) 13 Acres

An apparent natural great pond with no formal public access.

SOUTH SHORE STUDY AREA COMMUNITIES

1. Braintree

Old Quincy Reservoir (Reservoir Pond)
#6-11-40-7* (SS-23)+ 45 Acres

An artificial municipally-owned reservoir used for recreation. The dam and flowage rights are with the City of Quincy. No formal public access exists.

Sunset Lake (Little Pond) #6-11-40-6 (SS-24) 57 Acres

An apparent enlarged great pond. A municipal boat ramp on town property affords local recreational access, but there is no formal public access. The dam and flowage rights are with the Town of Braintree.

Smelt Brook Pond (SS-25) 20 Acres

A recently completed artificial pond which was a joint federal (Corps of Engineers) and local government flood control/recreation project. Public access is afforded through Broadmeadow Park, town recreation land. The dam and flowage rights are with the Weymouth-Braintree Recreation Conservation District.

Great Pond #6-11-40-4 (SS-24) 180 Acres

An apparent enlarged great pond serving as a local water supply reservoir, currently closed to any recreation. The dam and flowage rights are with the Braintree-Randolph Water Department.

Upper Reservoir #6-11-40-4 (SS-24) 165 Acres

(See Upper Reservoir, Randolph)

2. Cohasset

Lily Pond (SS-26) 46 Acres

An apparent natural great pond which is presently being enlarged to make a 155-acre town water supply reservoir. The water supply project, designated as the Aaron River Reservoir, has a scheduled completion date of December, 1977. No recreational use is contemplated for this reservoir.

3. Duxbury

Island Creek Pond (SS-28) 45 Acres

A natural great pond designated by the Division of Waterways (DEQE). Recreational use is aided by formal public access acquired by the Massachusetts Division of Waterways (DEQE). The Division of Waterways (DEQE) has issued one or more licenses to withdraw irrigation water from this pond.

Lower Chandler Pond (SS-29) 35 Acres

(See Lower Chandler Pond, Pembroke)

Garside (South River) Reservoir #7-12-82-5 (SS-28) 37 Acres

An artificial municipally-owned reservoir used for irrigation. There is informal access over town land for fishing and boating. The dam and flowage rights are with the town.

4. Hanover

Factory Pond #7-12-123-2 (SS-27) 55 Acres

An artificial pond (partly in Hanson) recently acquired by Plymouth County and subsequently turned over to the Hanover and Hanson Conservation Commissions for control and management. Recreational access can be obtained over town land. The dam and flowage rights are with the local Conservation Commissions.

5. Hanson

Factory Pond #7-12-123-2 (SS-27) 55 Acres

(See Factory Pond, Hanover)

6. Hingham

Accord Pond #7-12-131-5 (SS-26) 95 Acres

An apparent enlarged great pond (also in Norwell and Rockland) is used for a local water supply. The reservoir is currently open to shore fishing. The dam and flowage rights are with the Hingham Water Company. No formal public access has been provided.

7. Holbrook

Lake Holbrook (SS-24) 40 Acres

An artificial municipally-owned reservoir used for recreation. The dam and flowage rights are with the Town of Holbrook. No formal public access exists.

4. Chatham (continued)

Mill Pond (CC-37) 22 Acres

An apparent natural great pond. No formal public access has been provided.

Monomoy Point Big Pond (CC-37) 26 Acres

An apparent natural great pond with no public access presently provided.

Schoolhouse Pond (CC-37) 21 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). No formal public access is provided. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Stillwater Pond (CC-37) 16 Acres

An apparent natural great pond with no public access.

White Pond (CC-37) 40 Acres

A natural great pond surveyed by the Division of Waterways (DEQE), with no formal public access.

5. Dennis

Flax Pond (CC-38) 16 Acres

An apparent natural great pond for which no public access has been provided.

Fresh Pond (CC-38) 29 Acres

An apparent natural great pond. No public access has been provided.

Grassy Pond (CC-38) 12 Acres

An apparent natural great pond with no public access.

Kelley Pond (CC-38) 31 Acres

An apparent natural great pond with no formal public access.

Scargo Lake (CC-33) 53 Acres

A natural great pond designated by the Division of Waterways (DEQE) with no formal public access. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

5. Dennis (continued)

Simmons Pond (CC-38) 10 Acres

An apparent natural great pond with no public access.

White Pond (CC-38) 12 Acres

An apparent natural great pond with no public access.

6. Eastham

Depot Pond (CC-34) 25 Acres

An apparent natural great pond with no public access.

Great Pond #7-1-86-1 (CC-34) 109 Acres

An apparent enlarged great pond with no formal public access. The dam and flowage rights are owned by the Town of Eastham.

Minister Pond (Meetinghouse Pond) (CC-34) 21 Acres

An apparent natural great pond with no formal access.

Little Muddy Pond (CC-34) 11 Acres

An apparent natural great pond with no formal public access.

Herring Pond (CC-34) 43 Acres

An apparent natural great pond for which no public access has been provided. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

7. Falmouth

Cedar Pond (Flax, Cedar Lake) (CC-40) 21 Acres

An apparent natural great pond with no formal public access at present.

Coonamessett Pond (CC-40) 157 Acres

A natural great pond identified by the Division of Waterways (DEQE). There has been no formal public access provided.

Crooked Pond (CC-40) 34 Acres

A great pond surveyed by the Division of Waterways (DEQE) with no formal public access.

7. Falmouth (continued)

Deep Pond (CC-40) 27 Acres

A natural great pond surveyed by the Division of Waterways (DEQE), with no formal public access. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Flax Pond (Factory Pond) (CC-40) 21 Acres

An apparent enlarged great pond with no public access. The dam is owned by the Town of Falmouth as water storage for cranberry irrigation. A license from the Division of Waterways (DEQE) exists to withdraw water from the pond.

Flume Pond (CC-40) 11 Acres

An apparent natural great pond with no formal public access.

Fresh Pond (CC-40) 14 Acres

An apparent natural great pond. No formal public access has been obtained.

Grews Pond (CC-40) 13 Acres

An apparent natural great pond with no public access. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

Jenkins Pond (CC-40) 87 Acres

A natural great pond surveyed by the Division of Waterways (DEQE). There is no formal public access to these public waters.

Jones Pond (CC-40) 12 Acres

An apparent natural great pond. No formal public access has been provided.

Long Pond (CC-40) 150 Acres

A natural great pond identified by the Division of Waterways (DEQE). There is no public access to these public waters. It is used for water supply by the Town of Falmouth.

Mares Pond (CC-40) 28 Acres

A natural great pond designated by the Division of Waterways (DEQE). At present, there is no formal public access. It is presently stocked by the Massachusetts Division of Fisheries and Wildlife.

7. Falmouth (continued)

Morse Pond (CC-40) 15 Acres

An apparent natural great pond with no public access. A license from the Division of Waterways (DEQE) exists to withdraw water from the pond.

Oyster Pond (CC-40) 61 Acres

An apparent natural great pond with no formal public access.

Round Pond (CC-40) 19 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) with no formal public access. It is located near Jenkins Pond.

Round Pond (CC-40) 11 Acres

An apparent natural great pond which has no public access. It is located near Coonamessett Pond.

Shallow Pond (CC-40) 11 Acres

A natural great pond identified by the Division of Waterways (DEQE) with no formal public access.

Siders Pond (Fresh Pond) (CC-40) 34 Acres

A natural great pond identified by the Division of Waterways (DEQE) with no formal public access.

Spectacle Pond (CC-40) 19 Acres

A natural great pond surveyed by the Division of Waterways (DEQE) with no formal public access.

Wings Pond (Herring Pond) (CC-40) 21 Acres

An apparent natural great pond with no present formal public access.

8. Harwich

Aunt Edies Pond (CC-38) 19 Acres

An apparent natural great pond with no public access.

East Bells Neck Pond (Road Pond) (CC-38) 30 Acres

An apparent natural great pond with no formal public access.

8. Hull

No lakes, ponds, or reservoirs that meet criteria.

9. Kingston

Crossman's Pond (SS-29) 15 Acres

A natural great pond designated by the Division of Waterways (DEQE). Commercial recreation use is afforded by a small boat rental concern. The Division of Waterways (DEQE) has issued a license to withdraw irrigation water from this pond. No formal public access exists.

Lorings Bog Pond (Golden Reservoir)
#7-12-82-20 (SS-29) 15 Acres

An artificial municipally-owned reservoir used for irrigation with informal public access at present over town land for recreational use. The dam and flowage rights are with the town.

Indian Pond (SS-29) 66 Acres

An apparent great pond. There is public access for recreational use at present across town-owned land. The Division of Waterways (DEQE) has issued one or more licenses for the withdrawal of irrigation water from this pond.

Muddy Pond (Lake Providence) (SS-29) 41 Acres

A natural great pond designated by the Division of Waterways (DEQE). There is no public access. The Division of Waterways (DEQE) has issued a license for irrigation water withdrawal from the pond.

Silver Lake (SS-27) 640 Acres

(See Silver Lake, Pembroke)

Smelt Pond (SS-29) 44 Acres

A natural great pond designated by the Division of Waterways (DEQE). Limited public recreational use takes place on this pond. The Division of Waterways (DEQE) has issued one or more licenses for irrigation water withdrawal from this pond. No formal public access exists.

10. Marshfield

No lakes, ponds, or reservoirs meet criteria.

11. Norwell

Accord Pond #7-12-131-5 (SS-26) 95 Acres

(See Accord Pond, Hingham)

Jacobs Pond #7-12-219-4 (SS-27) 55 Acres

A municipally-owned artificial reservoir with limited recreational use due to poor water quality. The dam and flowage rights are with the Town of Norwell.

12. Pembroke

Furnace Pond (SS-27) 112 Acres

A natural great pond designated by the Division of Waterways (DEQE). The pond, currently open to public recreational use across town land, is used as a water supply adjunct for the Town of Brockton. There is no formal public access.

Hobomock Pond (SS-27) 15 Acres

An apparent natural great pond. There is presently informal access over town land to a beach area for residents. A private recreation camp also can be found on this pond. There is no formal public access.

Oldham Pond (SS-27) 235 Acres

A natural great pond designated by the Division of Waterways (DEQE). There is presently informal access over town land to a beach area for town residents. One or more licenses have been issued by the Division of Waterways (DEQE) for irrigation water withdrawal from this pond. There is no formal public access.

Great Sandy Bottom Pond (SS-27) 109 Acres

A natural great pond designated by the Division of Waterways (DEQE). The pond serves as water supply for the Towns of Rockland and Abington and presently is closed to any recreational use.

Little Sandy Bottom Pond (SS-27) 61 Acres

A natural great pond designated by the Division of Waterways (DEQE). One or more licenses have been issued by the Division of Waterways (DEQE) to withdraw irrigation water from this pond. Public access can be gained at present across town-owned land, but no formal public access has been obtained.

12. Pembroke (continued)

Silver Lake (SS-27) 640 Acres

An apparent natural great pond. This large pond, partly in the Towns of Kingston, Halifax, and Plympton serves as a water supply for the City of Brockton and is closed to any recreational use.

Stetson Pond (TA-49) 93 Acres

A natural great pond designated by the Division of Waterways (DEQE). A boat landing on town land provides local access for recreational use. The Division of Waterways (DEQE) has issued one or more licenses to withdraw irrigation water from this pond. There is no formal public access.

13. Plymouth

Abner Pond (BB-41) 10 Acres

A natural great pond designated by the Division of Waterways (DEQE). There is limited recreational use due to the presence of a Boy Scout camp on this pond. However, no formal public access exists.

Bartlett Pond (SS-30) 32 Acres

A natural great pond designated by the Division of Waterways (DEQE). Recreational fishing access is presently available over town land. No formal public access has been provided.

Darby Pond #7-12-239-32 (BB-42) 30 Acres

An apparent enlarged great pond. The pond is used for recreation and irrigation. One or more licenses have been issued by the Division of Waterways (DEQE) to withdraw water. Because two separately owned dams are found on this pond, the flowage rights are shared between the Boy Scouts and Robert Alberghini. No public access exists.

Deer Pond (BB-41) 10.2 Acres

An apparent natural great pond with no public access.

Doctors Pond (BB-41) 2 Acres

A small natural pond which is part of Myles Standish State Park under the control of the DEM. The pond is used for fishing. Informal public access is available across this state land.

13. Plymouth (continued)

Elbow Pond (SS-31) 16 Acres

An apparent natural great pond. A Boy Scout camp controls much of the recreational access to this pond. The Division of Water-Ways (DEQE) has issued a license to withdraw irrigation water from this pond. There is no formal public access.

Ellis Pond (BB-43) 11 Acres

A natural great pond designated by the Division of Waterways (DEQE). There is no formal public access. A private campground controls much of the shoreline.

Ezekial Pond (BB-41) 36 Acres

An apparent natural great pond. There is a small private beach area for surrounding cottage residents. No formal public access exists.

Fawn Pond #7-12-239-45 (BB-41) 45 Acres

An enlarged great pond designated by the Division of Waterways (DEQE). A Boy Scout camp owns much of the shoreland controlling access. The Division of Waterways (DEQE) has issued one or more licenses for irrigation water withdrawal. The dam and flowage rights are with A. D. Makepeace Company. No formal public access exists.

Fearing Pond (BB-41) 24 Acres

An apparent natural great pond is within the Myles Standish State Park under the control of the DEM. Informal public access for recreation is available across the state land.

Five Mile Pond #7-12-239-49 (BB-41) 29 Acres

An enlarged great pond designated by the Division of Waterways (DEQE). There is a Boy Scout camp on the pond. The Division of Waterways (DEQE) has issued a license for irrigation water withdrawal. The dam and flowage rights are with the Boy Scouts of America. No formal public access exists.

Fresh Pond #7-12-239-26 (SS-30) 62 Acres

An apparent enlarged great pond. A town beach area and boat landing have been developed. The Division of Waterways (DEQE) has issued a license for irrigation water withdrawal. The dam and flowage rights are with the United Cape Cod Cranberry Company. No formal public access has been provided.

13. Plymouth (continued)

Gallows Pond (SS-30) 43 Acres

A natural great pond designated by the Division of Waterways (DEQE). Two Girl Scout camps are on this pond. There is no formal public access to these public waters.

Big West Pond (SS-30) 40 Acres

An apparent natural great pond. Informal public recreational access can be gained through state land, as this pond is adjacent to Myles Standish State Park.

Little West Pond (SS-30) 25 Acres

An apparent natural great pond. Informal public access for recreation is afforded through state land, as this pond is adjacent to the Myles Standish State Park.

Grassy West Pond (SS-30) 20 Acres

An apparent natural great pond. Informal public recreational access is afforded across state land. This pond is adjacent to the Myles Standish State Park.

Gunners' Exchange Pond (SS-30) 29 Acres

An apparent natural great pond in the Myles Standish State Park under the control of the DEM. Fishing is the principal recreational use of this pond. The Division of Waterways (DEQE) has issued a license for the withdrawal of irrigation water from this pond. Informal public access can be gained over state land.

Hoyt's Pond (SS-30) 16 Acres

An apparent natural great pond in the Myles Standish State Park under the control of the DEM. Fishing is the principal recreational use of this pond. The Division of Waterways (DEQE) has issued a license for the withdrawal of irrigation water from this pond. Informal public access is available over state land.

Halfway Pond (BB-41) 232 Acres

An apparent natural great pond. The shoreline of this pond is presently posted against fishing. The Division of Waterways (DEQE) has issued a license for the withdrawal of irrigation water from this pond. No formal public access has been obtained.

13. Plymouth (continued)

Hedges Pond (SS-31) 26 Acres

An apparent natural great pond. Recreational access to this pond is quite limited due to the presence of a private recreation camp. No formal public access has been obtained.

Great Herring Pond (SS-31) 410 Acres

An enlarged great pond designated by the Division of Waterways (DEQE). Formal public access for boating has been obtained by the Massachusetts Public Access Board on the Bourne portion of the pond. One or more licenses exist to withdraw irrigation water from the pond.

Little Herring Pond (SS-31) 90 Acres

An enlarged great pond designated by the Division of Waterways (DEQE). The Division of Waterways (DEQE) has acquired formal public access allowing for recreational use of this pond.

Island Pond (SS-30) 12 Acres

An apparent natural great pond. This pond is used for fishing, although no formal public access is provided.

Great Island Pond #7-12-239-27 (SS-30) 77 Acres

An apparent enlarged natural great pond used for bog irrigation and recreation. The Division of Waterways (DEQE) has issued one or more licenses for the withdrawal of irrigation water. The dam and flowage rights are with George R. Briggs. There is no formal public access.

Little Island Pond #7-12-239-24 (SS-30) 30 Acres

An enlarged great pond designated by the Division of Waterways (DEQE). This Division has issued a license for irrigation water withdrawal. The pond shoreline is posted to any recreational use. There is no public access. The dam and flowage rights belong to George R. Briggs.

King's Pond (BB-43) 25 Acres

A natural great pond designated by the Division of Waterways (DEQE). The pond is used for recreation as well as bog irrigation. The Division of Waterways (DEQE) has issued a license for water withdrawal. No formal public access has been obtained.

13. Plymouth (continued)

Little Pond (SS-30) 43 Acres

An apparent natural great pond. The Town of Plymouth has developed a fee use beach which is presently open to both town residents and the general public, but no formal public access has been obtained.

Long Pond (BB-41) 211 Acres

A natural great pond designated by the Division of Waterways (DEQE). Formal public access has been obtained and a boat ramp developed by the Massachusetts Public Access Board. One or more licenses exist at the Division of Waterways (DEQE) to withdraw water from the pond.

Little Long Pond (BB-41) 45 Acres

An apparent natural great pond. Formal public access for portable boats has been obtained at the south end of the pond by the Massachusetts Public Access Board. The Division of Waterways (DEQE) has issued one or more licenses to withdraw water.

New Long Pond (BB-41) 23 Acres

An apparent natural great pond within the Myles Standish State Park under the control of the DEM. This pond is used for all types of recreation. Informal access is gained over state land.

Lout Pond (SS-30) 18 Acres

An apparent natural great pond. The pond serves as a secondary town water supply for Plymouth. Fishing from shore and nonpower boats is presently permitted, but no formal public access has been obtained.

Micajah Pond (SS-30) 20 Acres

An apparent natural great pond. The pond is used for fishing and boating. No formal public access exists.

Morey's Hole Pond (SS-30) 20 Acres

An apparent natural great pond. The presence of a Boy Scout camp somewhat restricts public use. The Division of Waterways (DEQE) has issued a license for irrigation water withdrawal. No formal public access has been obtained.

13. Plymouth (continued)

Powder Horn Pond (SS-30) 10 Acres

An apparent natural great pond with limited recreational use. No formal public access has been obtained.

Rocky Pond #7-12-239-43 (BB-43) 20 Acres

An artificial pond used for experimentation on cranberry bog irrigation. Informal recreational access exists, however, through Myles Standish State Park. The dam and flowage rights belong to the University of Massachusetts.

Big Rocky Pond (BB-41) 20 Acres

An apparent natural great pond. No formal public access has been obtained.

Little Rocky Pond (BB-41) 11 Acres

An apparent natural great pond. No formal public access has been obtained.

Round Pond (BB-41) 22 Acres

An apparent natural great pond. Much of the surrounding land is privately-owned restricting recreational access. No formal public access has been obtained.

Big Sandy Pond (BB-41) 135 Acres

An apparent natural great pond. Public recreational access is afforded through a state-built boat ramp.

Little Sandy Pond (BB-41) 29 Acres

A natural great pond designated by the Division of Waterways (DEQE). The Division of Waterways (DEQE) has issued a license for irrigation water withdrawal from this pond.

Savery Pond (SS-31) 32 Acres

An apparent natural great pond. The presence of many surrounding private cottages makes the pond quite inaccessible to public use. There is no formal public access.

Great South Pond (SS-30) 292 Acres

An apparent natural great pond. This pond, serving as a secondary town water supply, is closed to recreation except for fishing by permit for town residents only. The Division of Waterways (DEQE) has issued one or more licenses for irrigation water withdrawal.

13. Plymouth (continued)

Little South Pond (SS-30) 62 Acres

An apparent natural great pond. The pond serves as a primary town water supply and, as such, is closed to any recreational use.

Three Cornered Pond (BB-41) 14 Acres

A natural pond, part of the Myles Standish State Park, under the control of the DEM. A small access ramp allows for canoeing and fishing. Informal public access can be gained over state land.

Triangle Pond (SS-31) 10 Acres

An apparent natural great pond. Recreational access is quite limited due to surrounding private cottages.

South Triangle Pond (SS-30) 19 Acres

An apparent natural great pond with very limited recreational use. No formal public access has been obtained.

Wall Pond (BB-41) 12 Acres

This is an apparent natural great pond. At present, public access for fishing is available across a small beach area. There is no formal public access.

Whites Pond (BB-41) 33 Acres

This is an apparent natural great pond. Some fishing and boating use occurs on this pond. The Division of Waterways (DEQE) has issued a license for irrigation water withdrawal. No formal public access has been obtained.

Widgeon Pond (BB-43) 24 Acres

This apparent natural great pond is part of the Myles Standish State Park under the control of DEM. Recreational access is difficult, due to the presence of surrounding leased cottages, but informal public access can be obtained across the state land.

14. Plympton

Silver Lake (SS-27) 640 Acres

(See Silver Lake, Pembroke)

15. Quincy

No lakes, ponds, or reservoirs meet criteria.

16. Randolph

Upper Reservoir #6-11-40-4 (SS-24) 165 Acres

An artificial reservoir serving as a local water supply. The reservoir is currently closed to recreation. The dam and flowage rights are with the Town of Braintree.

17. Rockland

Accord Pond #7-12-131-5 (SS-26) 95 Acres

(See Accord Pond, Hingham)

Studley's Pond (Reeds Pond) #7-12-251-1 (SS-24) 26 Acres

An artificial municipally-owned pond used principally for local recreation. The pond is presently being dredged out to effectuate water quality improvement. The dam and flowage rights are with the Town of Rockland.

18. Scituate

Wagner's Meadow Reservoir #7-12-264-5 (SS-27) 80 Acres

An artificial municipally-owned reservoir used for water supply. The reservoir is closed to recreation. The dam and flowage rights are with the Town of Scituate.

19. Weymouth

Weymouth Great Pond #6-11-336-2 (SS-26) 290 Acres

An apparent enlarged great pond. The pond is withdrawn as a local water supply. It is closed currently to public recreational use.

Whitmans Pond #6-11-336-3 (SS-26) 175 Acres

An enlarged great pond designated by the Division of Waterways (DEQE). The dam and flowage rights are with the Town of Weymouth. The pond serves as part of the town's water supply. It is open at present for public recreation. Access can be gained across town land off Route #53.

ERRATA SHEET FOR APPENDIX C

The following ponds should be added:

ISLANDS STUDY AREA COMMUNITIES

5. West Tisbury (on Page C-51)

Tisbury Great Pond (IS-69) 772 Acres

This is a natural great pond identified by the Massachusetts Division of Waterways (DEQE). No formal public access has been obtained.

SOUTH SHORE STUDY AREA COMMUNITIES

13. Plymouth (on Page C-57)

Billington Sea #7-12-239-9 (SS-30) 269 Acres

This is an enlarged great pond as designated by the Division of Waterways (DEQE). Recreation is presently afforded through informal access to a town boat ramp. The dam and flowage rights are with the Town of Plymouth. There is no formal public access.

Bloody Pond (SS-31) 94 Acres

This is a natural great pond designated by the Division of Waterways (DEQE). There is limited public usage due to the presence of a private recreational camp controlling much of the shoreline. The Division has issued one or more licences to withdraw irrigation water from this pond. No formal public access has been obtained.

Boot Pond (SS-30) 72 Acres

This is an apparent natural great pond. There is limited public usage due to the presence of a private recreational camp. No formal access has been provided.

Charge Pond (BB-41) 23 Acres

This natural pond is part of Myles Standish State Park under the control of the Massachusetts Department of Environmental Management. This pond is used for fishing and swimming. Informal access is available to the public across this state land.

13. Plymouth (continued)

Clear Pond (BB-42) 12 Acres

This is an apparent natural great pond. Town land presently provides access to two small beach areas. The Division of Waterways has issued one or more licenses to withdraw irrigation water from the pond.

College Pond (BB-41) 53 Acres

This natural pond is part of Myles Standish State Park under the control of the Massachusetts Department of Environmental Management. This pond has a beach area for swimming and is used also for boating and fishing. Informal public access is available across this state land.

Cooks Pond #7-12-239-31 (SS-30) 23 Acres

This is an apparent enlarged great pond. At present, recreational access can be gained through the Plymouth Town Forest. The Division of Waterways has issued one or more licenses for irrigation water withdrawal. The dam and flowage rights are with William Stearns, Water Course Bogs, Inc.

Curlew Pond (BB-43) 43 Acres

This natural pond is part of Myles Standish State Park under the control of the Massachusetts Department of Environmental Management. Most of the pond's recreational use is by surrounding cottage residents. Informal access is gained through state land.

APPENDIX D

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